DOCUMENT RESUME

ED 181 256 CE 023 768

TITLE	Agriculture Education. Farm Machinery.
INSTITUTION	Stuttgart Public Schools, Ark.
SPONS AGENCY	Arkansas State Dept. of Education, Little Rock. Div. of Vocational Education.
NOTE	374p.: Parts of this document may not reproduce well due to light type: For related documents see CE 023 758 and CE 023 767-771
EDRS PRICE	MF01/PC15 Plus Postage.
DESCRIPTORS	*Agricultural Education: *Agricultural Engineering: *Agricultural Machinery: Curriculum Guides: Employment Opportunities: *Engines: Hydraulics: Instructional Materials: Learning Activities: Machinery Industry: Secondary Education: Teaching Guides: Tests: *Tractors: *Vocational Agriculture

ABSTRACT

This curriculum guide is designed for group instruction of secondary agricultural education students enrolled in one or two semester-long courses in farm machinery. The guide presents units of study in the following areas: (1) small gas engines, (2) job opportunities, (3) tractors, (4) engines, (5) hydraulics, (6) electrical system, (7) combine operation, (8) hay and forage equipment, and (9) machinery management. Each of the thirteen units of instruction follows a typical format: terminal objective, specific objectives, suggested instructor and student activities, instructional materials, information sheet, transparency masters, assignment sheets, and a student test. (LRA)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

AGRICULTURE EDUCATION

ED181256

2-13-80

ARKANSAS

CE 023768

FARM MACHINERY

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

"PERMISSION TO REPRODUCE THIS
MATERIAL HAS BEEN GRANTED BY

Luther Hardin

TO THE EDUCATIONAL RESOURCES
INFORMATION CENTER (ERIC)."

PREFACE

This curriculum guide is a suggested method of group instruction for students enrolled in one or two semester-long courses in Agriculture Education.

This material is intended to cover those items which a student will most likely encounter when employed in this given area of agriculture.

Individualized instructional material should be supplemented to this curriculum guide to meet individual and local needs.

This curriculum guide contained herein was performed pursuant to a contract with the Exemplary Section, Division of Vocational, Technical and Adult Education, Arkansas Department of Education.

ACKNOWLEDGEMENT

Appreciation is expressed to the many individuals who gave their time and knowledge to the preparation of this publication. Without the combined efforts of the State Department of Agriculture Education, the Stuttgart Public School System and the teachers of Vocational Agriculture, this publication would not have been possible.

The content of this publication was prepared and reviewed by:

AGRICULTURE EDUCATION STAFF
STUTTGART PUBLIC SCHOOLS

Ned Moseley	Superintendent
J.E. Lawrence	Principal
Joe C. Williams	Principal
John Gentry	Soybean and Rice Production
Glenn Aubrey	Soybean and Rice Production
Vincent Lum	Soybean and Rice Production
Anthony Ashlock	Farm Machinery
Roger Clark	Horticulture
James Rodgers	Horticulture
James Branson	Elements of Farm and Building Layout
Greg Goss	Agriculture Structures
Harlan Peacock	Agriculture Structures
John C. Davis	Agriculture Structures
Richard Gray	Agricultural Metal Working
Wayne Smith	Agricultural Metal Working
James Phillips	Agricultural Metal Working

INSTRUCTORS OF VOCATIONAL AGRICULTURE

Dick Pirkey
Danny Blalock
Billy Watkins
James Gambill
Johnny Neel
Martin Gosset
Dale Thompson
Tom Walker
Lee Griffith
Jack Warnock
Ralph A. Cheshier
Ron Highfill
Wallace Wortham
Jackie Brown
Jack McCord
David Nordin
Garlen T. Willis
Thomas G. Baker
Jim Penn
Troy W. Buck
James Morris
Jimmy Stotts
Thomas Craig
Melvin Daniel
Tommie L. Brown
Jesse F. Bush
Reuben McClelland
Gary Hines
Glen Tice
Terry Waits
David Montgomery
J.R. Buckner

Jerry S. Speir
Howard Easterling
Phillip Rows
James Neely
Harold Ramsey
Emmit Biswell
David Holcombe
Bruce Rylant
William O. McCoy
Tilman Adams
Clyde West
Charles Harvill
Terry Williams
Glynn Gibson
Eddie Plunkett
John Rankin
David Marcantel
James Nicholson
Jerry Davis
Bob Misenheimer
Gary McGhee
Richard L. Penn
Sam Mullins
Marion Spaulding
Patrick Sullivan
Lanny Rice
James Floyd
Ben Lawrence
Danny Allen
William Stark
John Turner
Mickey Sweeney
Jack Watkins
Herman Scott
Gail Thrower
James Boyd
Floyd Gray
Malcolm Patterson
Skip Emmett
Tommie Hill

STATE DEPARTMENT OF EDUCATION VOCATIONAL STAFF

James Dasher
Robert Crawley
Unice Latimer
Bob Verboon
Travis Hopper
Don Harlan
Marion Fletcher
Linda Beene
Peggy Patrick

Other contributors were;

Ciba Geigy Corporation, Greensboro, North Carolina

Alabama State Department of Education, Auburn, Alabama

New Mexico State Department of Education, Santa Fe, New Mexico

State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, Stillwater, Oklahoma

John Deere and Company, Moline, Illinois

American Association for Vocational Instructional Materials, Room 120, Engineering Center, Athens, Georgia

Hobar Publications, St. Paul, Minnesota

McGraw Hill Book Company, New York, New York

Gratitude is expressed to Jarris Phillips and Rose Mary Jeffery for their help on the illustrations and drawings used in this publication.

Special thanks to JoAnn Newton and Ruth Peacock for their help in printing this publication.

Appreciation goes to Bonnie Branson and Rebecca Grandgeorge for their help in editing this material.

Special thanks to Barbara Hartsell and Brenda Neighbors for composing and typing this publication.

TABLE OF CONTENTS

FARM MACHINERY

Section A - Small Gas Engines

Unit I Compression
Unit II Ignition
Unit II Carburetion

Section B - Job Opportunities

Unit IV Job Opportunities

Section C - Tractors

Unit V Tractor Safety
Unit VI Tractor Operation
Unit VII Preventive Maintenance

Section D - Engines

Unit VIII Engines

Section E - Hydraulics

Unit IX Hydraulics

Section F - Electrical System

Unit X Electrical System

Section G - Combine Operation

Unit XI Combine Operation

Section H - Hay and Forage Equipment

Unit XII Hay and Forage Equipment

Section I - Machinery Management

Unit XIII Machinery Management

UNIT I

COMPRESSION

COMPRESSION

TERMINAL OBJECTIVE

The student, upon completion of Unit I, should be able to; understand the principles of the 4-cycle and 2-cycle engines, develop the ability to identify the parts and thier function in compression, and to develop the skills of disassembly and the reassembly of the small gas engine. This knowledge will be evidenced through demonstration and by scoring at least eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit of instruction, the student should be able to:

I. Match twenty-five terms associated with compression and the principles of operation.

II. Name the four strokes of a 4-cycle engine and list the principle events of each stroke.

III. Name the two strokes of a 2-cycle engine and list the principle events of each stroke.

IV. Identify seven parts of a valve.

V. Name four types of valve spring locks.

VI. Identify the three types of improperly maintained valves.

VII. List six items of information that appear on name plates.

VIII. Name five advantages why small gas engines are so easily adapted to a job.

IX. Name six machines powered by small gas engines.

X. Write the formula for piston displacement and be able to work one problem using the formula.

XI. Name five parts of a piston.

XII. List three types of piston rings.

XIII. Name six types of oil distribution devices.

XIV. Name the three operating positions of small gas engines.

XV. Trouble shoot an engine failure associated with compression on a small gas engine.

XVI. Complete the information on an engine inspection chart.

XVII. Disassemble a small gas engine.

XVIII. Reassemble a small gas engine.

COMPRESSION

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with terminal and specific objectives, information sheets, and job sheets.

   B. Discuss the terms, parts, and thier function of a small gasoline engine concerning compression.

   C. Discuss the theory of a 4-cycle and a 2-cycle engine.

   D. Use a cut-away engine to demonstrate various operations.

   E. Make transparencies.

   F. Discuss the job sheets and demonstrate the procedures on the job sheets.

   G. Supply the student with an engine with a faulty compression system to trouble shoot the problem and repair.

   H. Give test.

II. Students:

   A. Study the information sheets provided by the instructor.

   B. Complete job sheet #1 and return to the instructor.

   C. Demonstrate the ability to perform the jobs listed on the job sheets.

   D. Demonstrate the ability to trouble shoot compression problems on the small gas engines.

   E. Take test.

INSTRUCTIONAL MATERIALS

I. Materials included in this unit:

   A. Objectives

B. Information sheets

C. Transparency masters

1. TM 1 - Strokes of a 4-cycle engine (4)

2. TM 2 - Strokes of a 2-cycle engine (4)

3. TM 3 - Parts of a valve

4. TM 4 - Types of valve spring retainer locks

5. TM 5 - Improperly maintained valves

6. TM 6 - Drive shaft positions

D. Job sheets

E. Test

F. Answers to test

II. References:

A. Oklahoma Vocational Agriculture Education, Basic Core Curriculum III, Stillwater Oklahoma, State Department of Vocational and Technical Education.

B. Briggs and Stratton Repair Instructions III, Milwaukee, Wisconsin, Briggs and Stratton Corp.

C. General Theories of Operation, Milwaukee, Wisconsin, Briggs and Stratton Corp.

D. Small Engines Care, Operation, Maintenance and Repair, Volume I, American Association for Vocational Instructional Materials.

E. Small Engines Maintenance and Repair, Volume II, American Association for Vocatinal Instructional Materials.

F. Jud Purvis, All About Small Gas Engines, The Goodheart Wilcox Co. Inc., 1963.

COMPRESSION

INFORMATION SHEET

I. Terms and definitions:

A. BORE - Cylinder diameter.

B. CAMSHAFT - Opens the valve and allows them to close by cams or lobes on the shaft.

C. COMBUSTION - The process of burning.

D. COMPRESSION - The reduction in volume or the "squeezing" of a gas.

E. COMPRESSION RATIO - The volume of the combustion chamber at the end of the compression stroke as compared to the volume of the cylinder and the chamber with the piston on bottom center.

F. CONNECTING ROD - Rod that connects the piston to the crankshaft.

G. CRANKSHAFT - The main shaft of an engine which in conjunction with the connecting rods,changes the reciprocating motion of the pistons into rotary motion.

H. CYLINDER - A round hole having some depth bored to receive a piston.

I. CYLINDER HEAD - A detachable portion of an engine fastened securely to the cylinder block which contains all or a portion of the combustion chamber.

J. EXHAUST VALVE - To regulate the flow of burnt gases from the cylinder and to aid in compression.

K. FLYWHEEL - A heavy wheel in which energy is absorbed and stored by means of momentum.

L. GASKET - Anything used as a packing, such as a non-metallic substance placed between two metal surfaces to act as a seal.

M. GOVERNOR - A device to control and regulate speed. May be mechanical, hydraulic or electrical.

INFORMATION SHEET

N. HP-HORSEPOWER - The energy required to lift 550 lbs. 1 ft. in 1 second.

O. INTAKE VALVE - To regulate the entering of air-fuel mixture and to hold it in the cylinder while it is compressed.

P. PISTON - A cylindrical part closed at one end which is connected to the crankshaft by the connecting rod. The force of the explosion in the cylinder is exerted against the closed end of the piston causing the connecting rod to move the crankshaft.

Q. PISTON DISPLACEMENT - The volume of air moved or displaced by moving the piston from one end of its stroke to the other.

R. PISTON RING - An expanding ring placed in the grooves of the piston to provide a seal to prevent the passage of fluid or gas past the piston.

S. ROD CAP - To connect the connecting rod to the crankshaft.

T. SPARK PLUG - A device which extends into the combustion chamber that ignites the fuel and air mixture.

U. STROKE - The distance moved by the piston.

V. TROUBLE SHOOTING - Refers to a process of diagnosing or deducing the source of the trouble or troubles from observation and testing.

W. VALVE CLEARANCE - The air gap allowed between the end of the valve stem and the valve lifter.

X. VALVE LIFTER - A push rod or plunger between the cam and the valve on an engine.

Y. VALVE SPRING - Closes the valves.

INFORMATION SHEET

II. Four strokes and the principle events of a four-cycle engine.

A. Intake stroke: TM 1-a

1. The intake valve is open.
2. The exhaust valve is closed.
3. The piston is moving downward creating a vacuum.
4. The fuel and air mixture is drawn into the cylinder by the vacuum, through the intake valve opening.

B. Compression stroke: TM 1-b

1. The intake and exhaust valves are closed.
2. The piston is moving upward.
3. The fuel and mixture is compressed in the combustion chamber.

C. Power stroke: TM 1-c

1. The intake and exhaust valves are closed.
2. The spark plug ignites the fuel and air mixture causing an explosion.
3. The explosion forces the piston down exerting power to the crankshaft.

D. Exhaust stroke: TM 1-d

1. The exhaust valve opens.
2. The intake valve remains closed.
3. The piston moves up forcing the burned gases out through the exhaust valve opening.
4. The exhaust valve closes.
5. The cycle is repeated.

INFORMATION SHEET

III. Two strokes and the principles of a two-cycle engine.

A. Stroke I - Power: TM 2-a

1. The spark plug ignites the fuel, oil, and air mixture.
2. The piston moves downward under pressue by the expanding gases.
3. The reed valve in the crankcase is closed due to pressure built up by the piston moving down.

B. Stroke I - Exhaust: TM 2-b

1. The piston continues to move downward under pressure.
2. The piston passes the exhaust port opening in the cylinder wall.

C. Stroke I - Intake: TM 2-c

1. The piston is still moving in the downward direction.
2. The piston passes the intake port opening allowing the fuel, oil, and air mixture to enter the cylinder.

D. Stroke II - Compression: TM 2-d

1. The piston begins to move upward.
2. The piston moves up closing off the intake port.
3. The piston continues to move up closing off the exhaust port.
4. The reed valve in the crankcase opens due to the vacuum created by the upward movement of the piston.
5. The fuel, oil, and air mixture enters the crankcase from the carburetor.

INFORMATION SHEET

6. The fuel is compressed into the combustion chamber.

7. The cycle is repeated.

IV. Seven parts of a valve: TM 3

  A. Head

  B. Margin

  C. Face

  D. Seat

  E. Valve Guide

  F. Stem

  G. Lock Groove

V. Four types of valve spring locks: TM 4

  A. Pin

  B. Split-Collar

  C. Retainer

  D. Slotted Disk

VI. Three types of improperly maintained valves: TM 5

  A. Burned

  B. Necked

  C. Dished

VII. Six items of information that appear on name plates.

  A. Make of engine

  B. Serial Number

  C. Model Number

  D. Size

  E. R.P.M.

INFORMATION SHEET

F. Specification Number

VIII. Five advantages why small gas engines are so easily adapted to a job.

A. Lightweight

B. Air Cooled

C. Easy to Service

D. Compact

E. Self-Contained

IX. Six machines powered by small gas engines.

A. Lawn Mowers

B. Garden Tillers

C. Weed Eaters

D. Elevators

E. Irrigation Pumps

F. Motor Cycles

X. Figuring piston displacement:

Formula: $\text{Piston Displacement} = \frac{(\text{Bore})}{4} \times \pi \times \text{Stroke}$

Example: An engine with a 2" bore and a 2" stroke

$\text{Piston Displacement} = \frac{2 \times 2}{4} \times 3.1416 \times 2$

Piston Displacement = 6.2832 cubic inches

XI. Five parts of a piston:

A. Piston Head

B. Piston Lands

C. Piston Pin

D. Piston Ring Groove

INFORMATION SHEET

E. Piston Skirt

XII. Three types of piston rings:

A. Compression Rings

B. Oil Scraping Rings

C. Oil Control Rings

XIII. Six types of oil distribution devices:

A. Dipper

B. Dipper with Pump

C. Oil Scoop

D. Oil Slinger

E. Gear Pump

F. Plunger Pump

XIV. Three operating positions of small gas engines: TM 6

A. Vertical

B. Horizontal

C. Multi-Position

XV. Trouble shooting; Compression

Symptom of trouble	Cause of improper function
A. Poor compression, smoke may be observed escaping from around the gasket.	A. Cylinder head loose or faulty gasket.
B. Poor compression, motor hard to start, and lacks power.	B. Worn piston, scored piston, or cracked piston. Worn rings or broken rings.

INFORMATION SHEET

			Worn cylinder wall, out of round, cracked or scored.
C.	Poor compression, motor hard to start or will not start, will not function under load.	C.	Burnt valves. Tappet clearance may prevent sealing. Necked valves. Dished valves. Gum or carbon deposits.
D.	Engine knock.	D.	Scored crankshaft. Worn piston pin hole. Out of round piston pin. Worn crankshaft. Crankshaft out of round.

XVI. Completing an inspection chart.

A. Students must refer to job sheet #1 to complete an engine inspection chart.

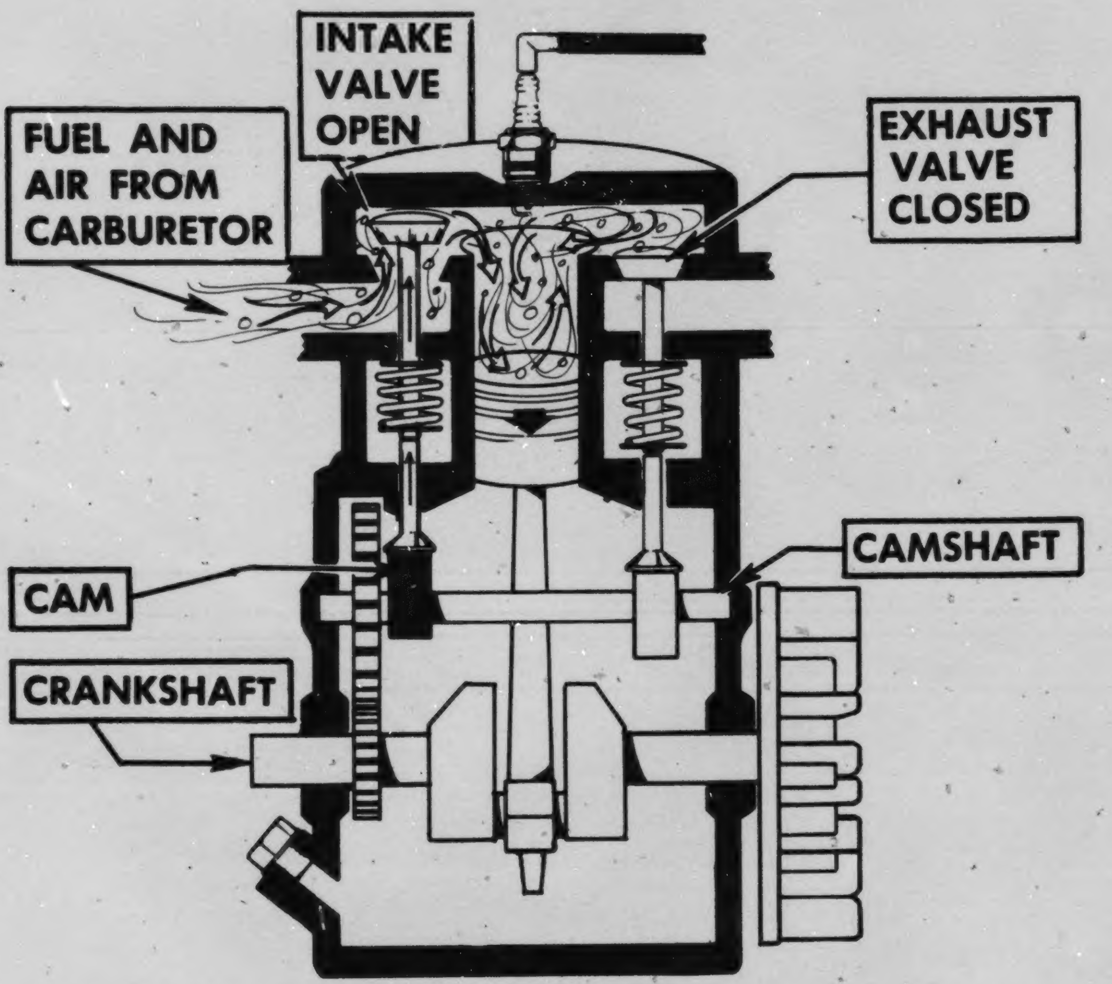
XVII. Disassemble a small gas engine.

A. The correct procedure for disassembling a small gas engine is listed on job sheet #2. The participant must perform this job in order to complete this objective.

XVIII. Reassemble a small gas engine.

A. The correct procedure for reassembling a small gas engine is listed on job sheet #3. The participant must perform this job in order to complete this objective.

4 CYCLE ENGINE
(OPERATING PRINCIPLE)

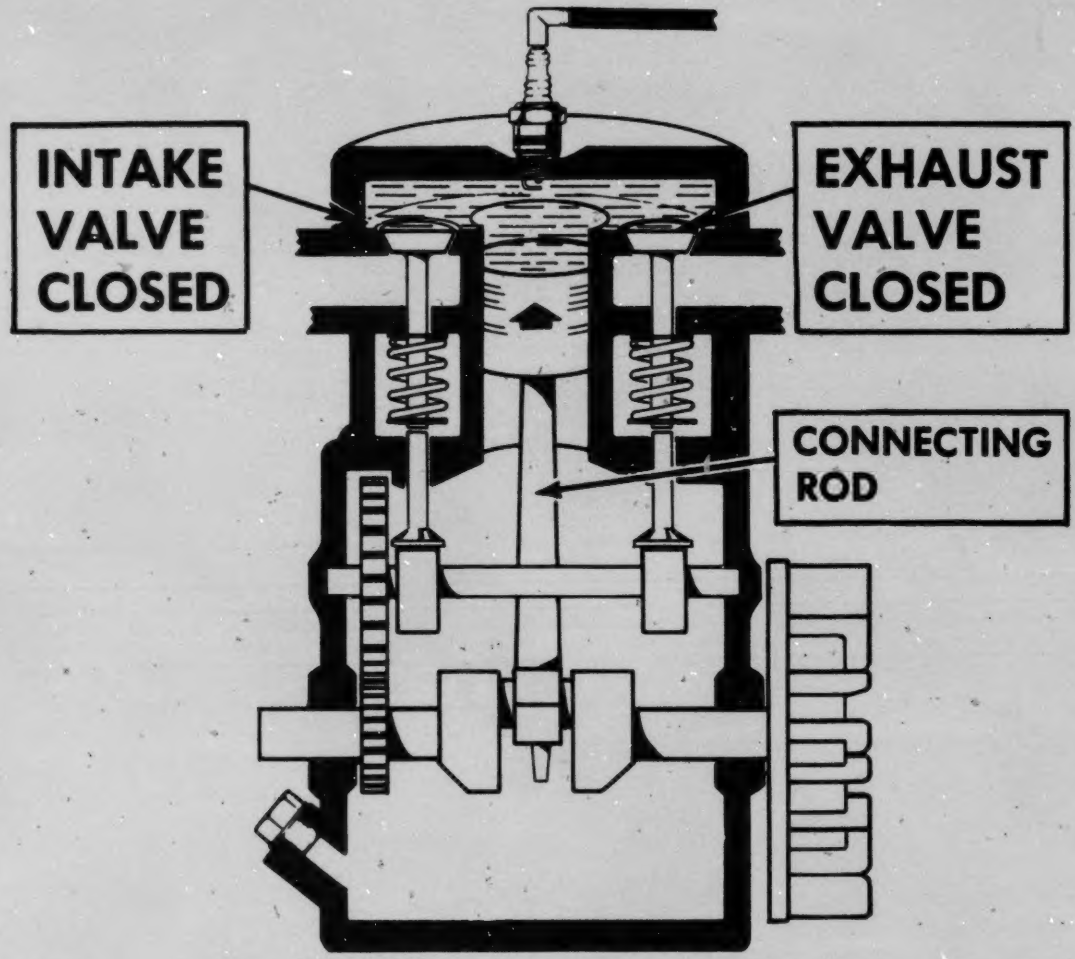

INTAKE VALVE OPEN
FUEL AND AIR FROM CARBURETOR
EXHAUST VALVE CLOSED
CAMSHAFT
CAM
CRANKSHAFT

INTAKE OR SUCTION STROKE

INTAKE, OR SUCTION STROKE – Descending piston develops partial vacuum. Fuel-and-air mixture is forced into the cylinder by atmospheric pressure from the carburetor and through the intake valve.

4 CYCLE ENGINE

(OPERATING PRINCIPLE)

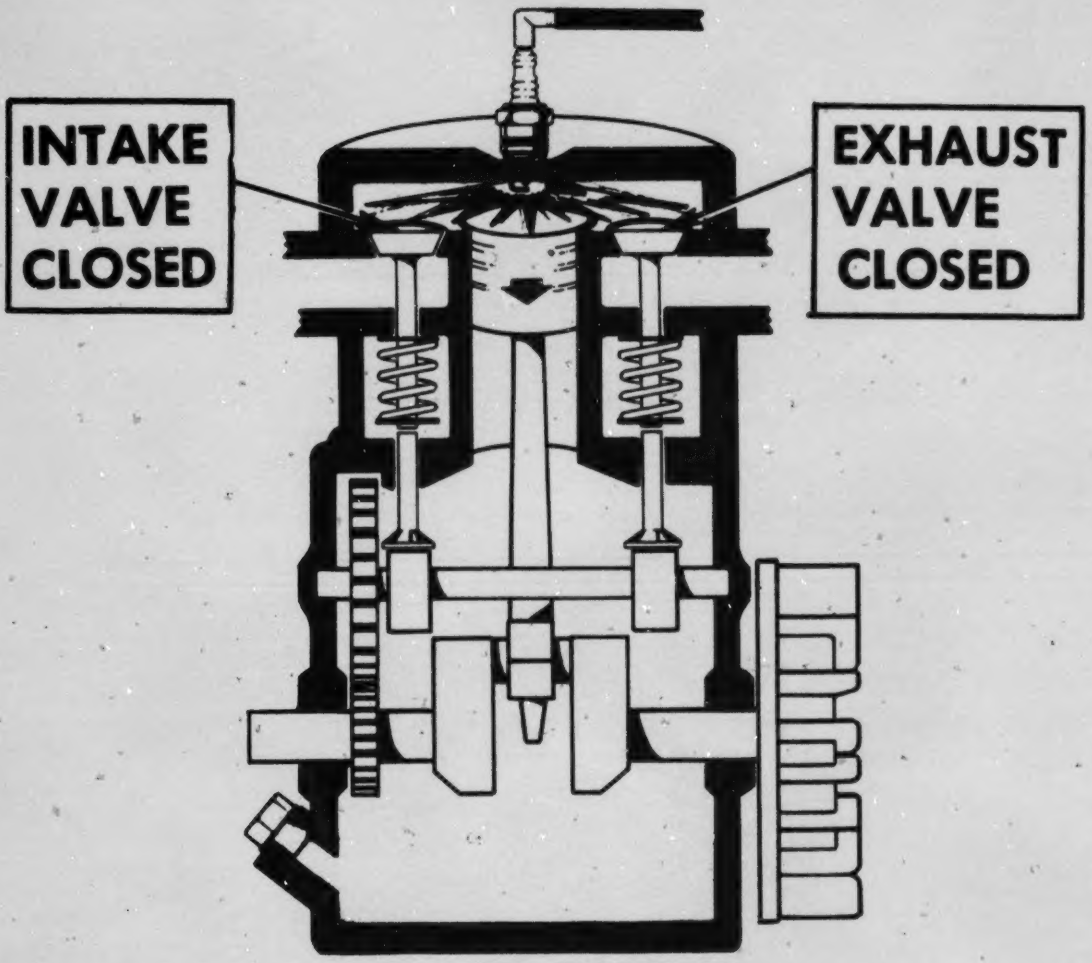

INTAKE VALVE CLOSED
EXHAUST VALVE CLOSED
CONNECTING ROD

COMPRESSION STROKE

COMPRESSION STROKE – Piston rises and compresses trapped fuel-air mixture.

4 CYCLE ENGINE

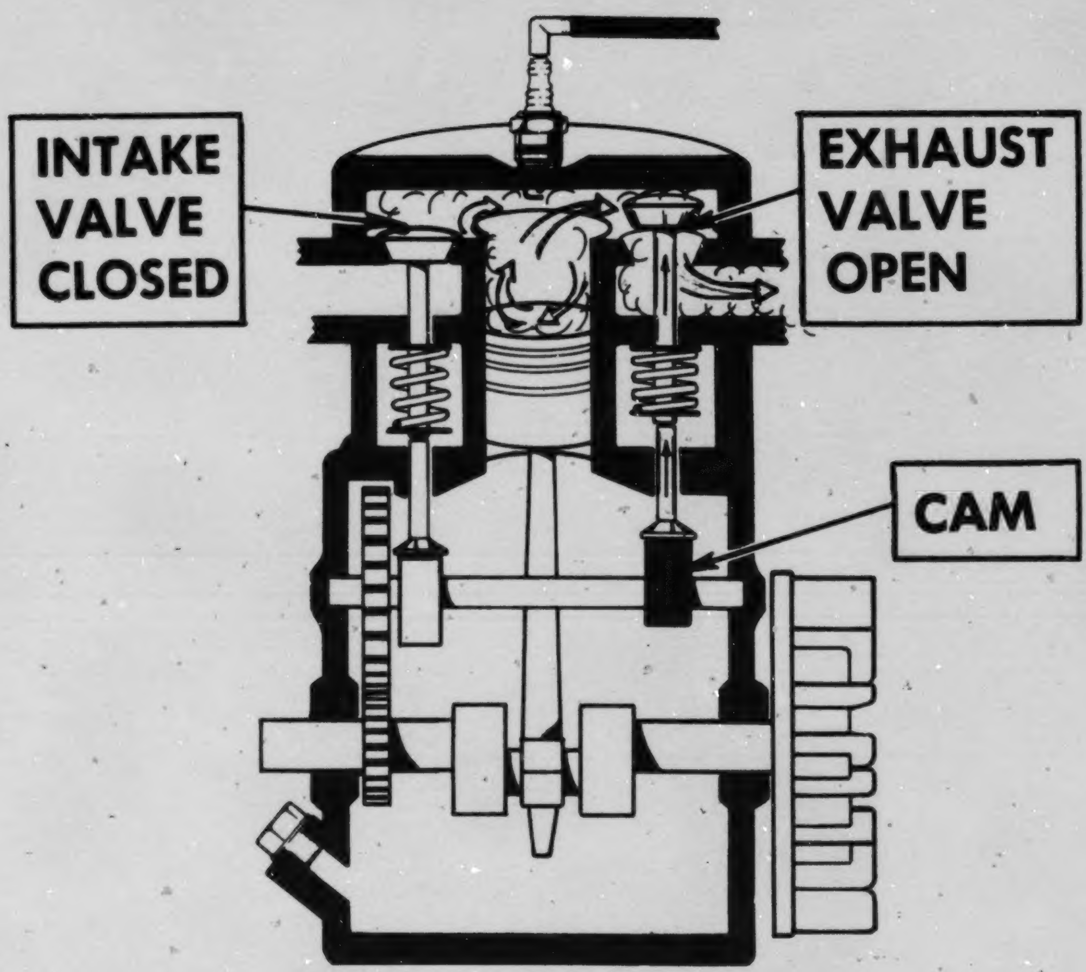
(OPERATING PRINCIPLE)


INTAKE VALVE CLOSED
EXHAUST VALVE CLOSED

POWER STROKE

POWER STROKE – Spark plug fires and ignites fuel-air mixture. The burning gas expands and forces the piston down.

4 CYCLE ENGINE
(OPERATING PRINCIPLE)

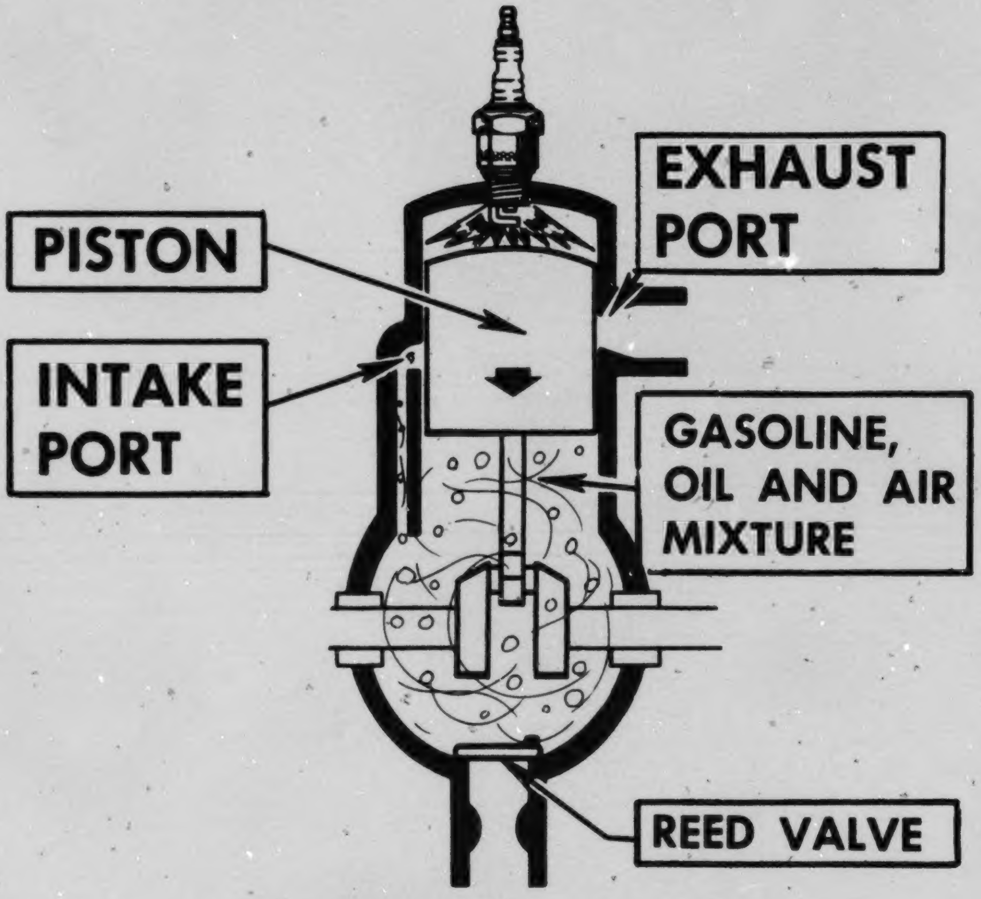

INTAKE
VALVE
CLOSED
EXHAUST
VALVE
OPEN
CAM

EXHAUST STROKE

EXHAUST STROKE – Piston moves upward and forces burned gases from the cylinder through the exhaust open valve.

2 CYCLE ENGINE

(OPERATING PRINCIPLE)

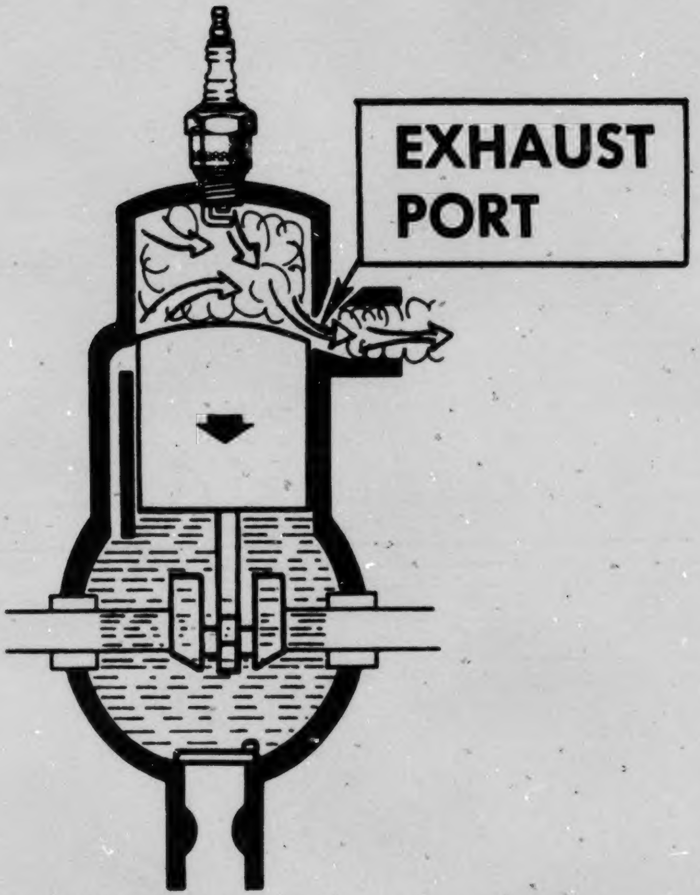

PISTON
INTAKE PORT
EXHAUST PORT
GASOLINE, OIL AND AIR MIXTURE
REED VALVE

STROKE I — POWER

Piston moves downward under pressure from expanding gases. Reed valve in crankcase closes. (Ignition occurred just before the downward stroke of the piston.)

2 CYCLE ENGINE

(OPERATING PRINCIPLE)

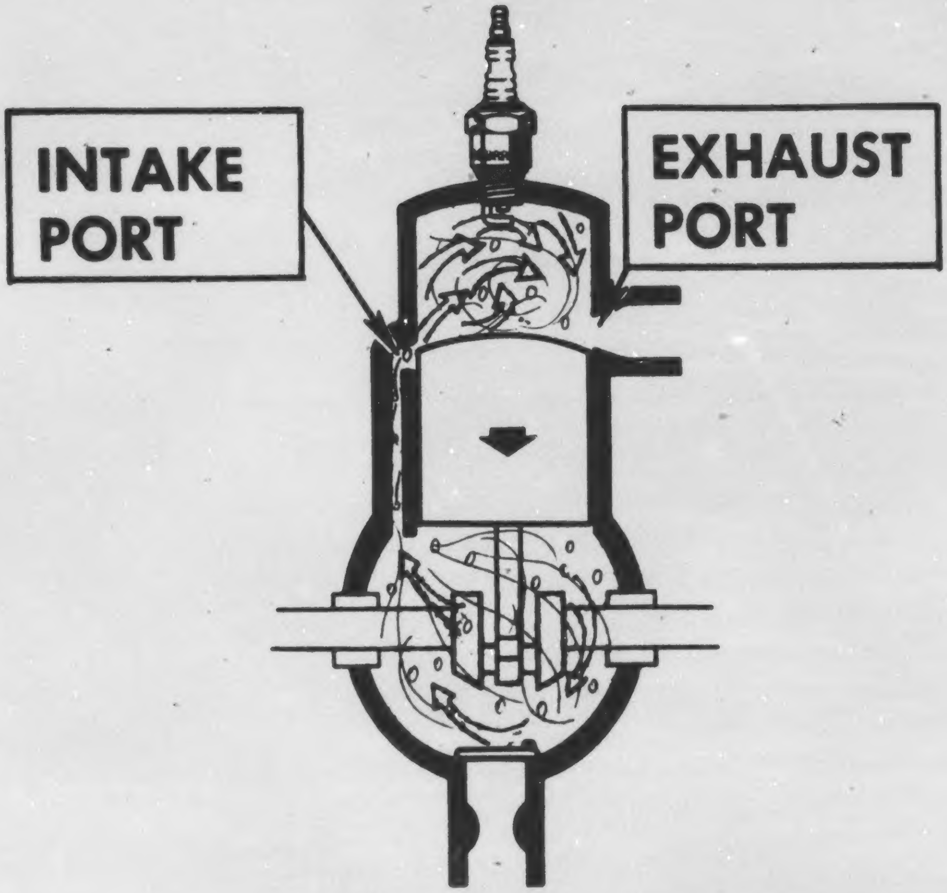


STROKE I — EXHAUST

Piston continues to move downward under pressure.
Exhaust port opens.

2 CYCLE ENGINE

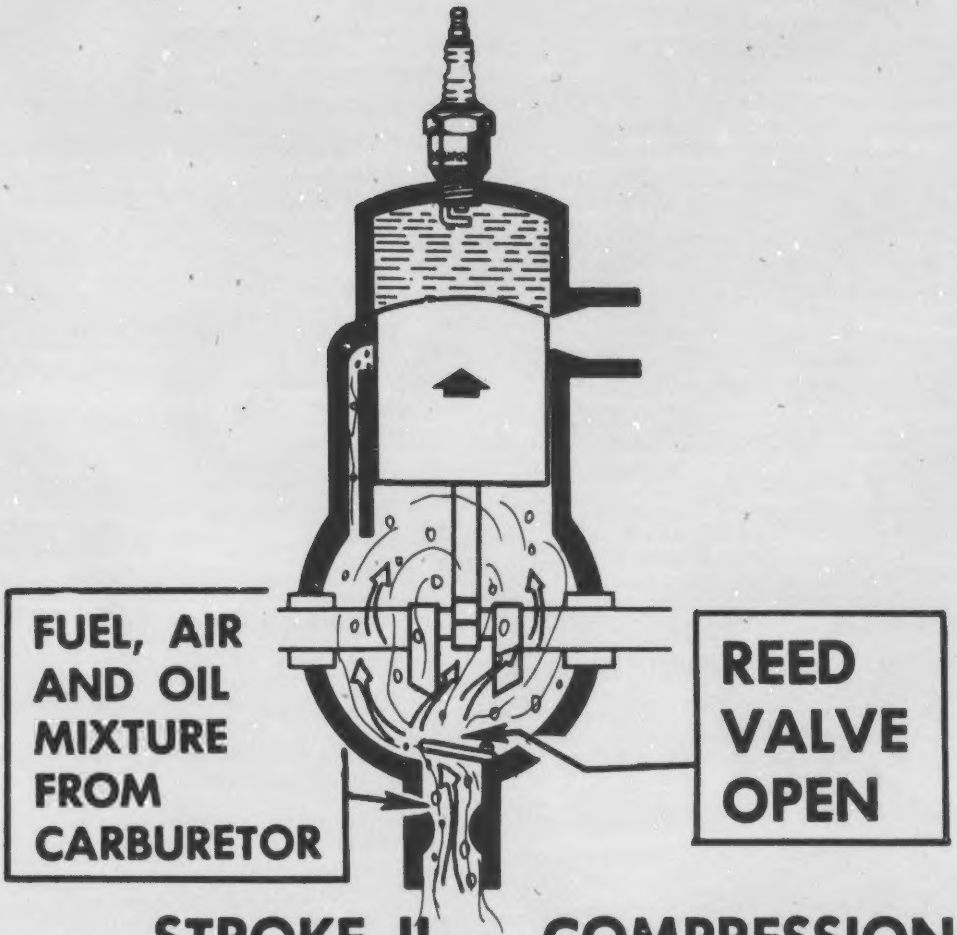
(OPERATING PRINCIPLE)


INTAKE PORT
EXHAUST PORT

STROKE I — INTAKE

Intake port opens. Fuel and oil mixture goes into cylinder.

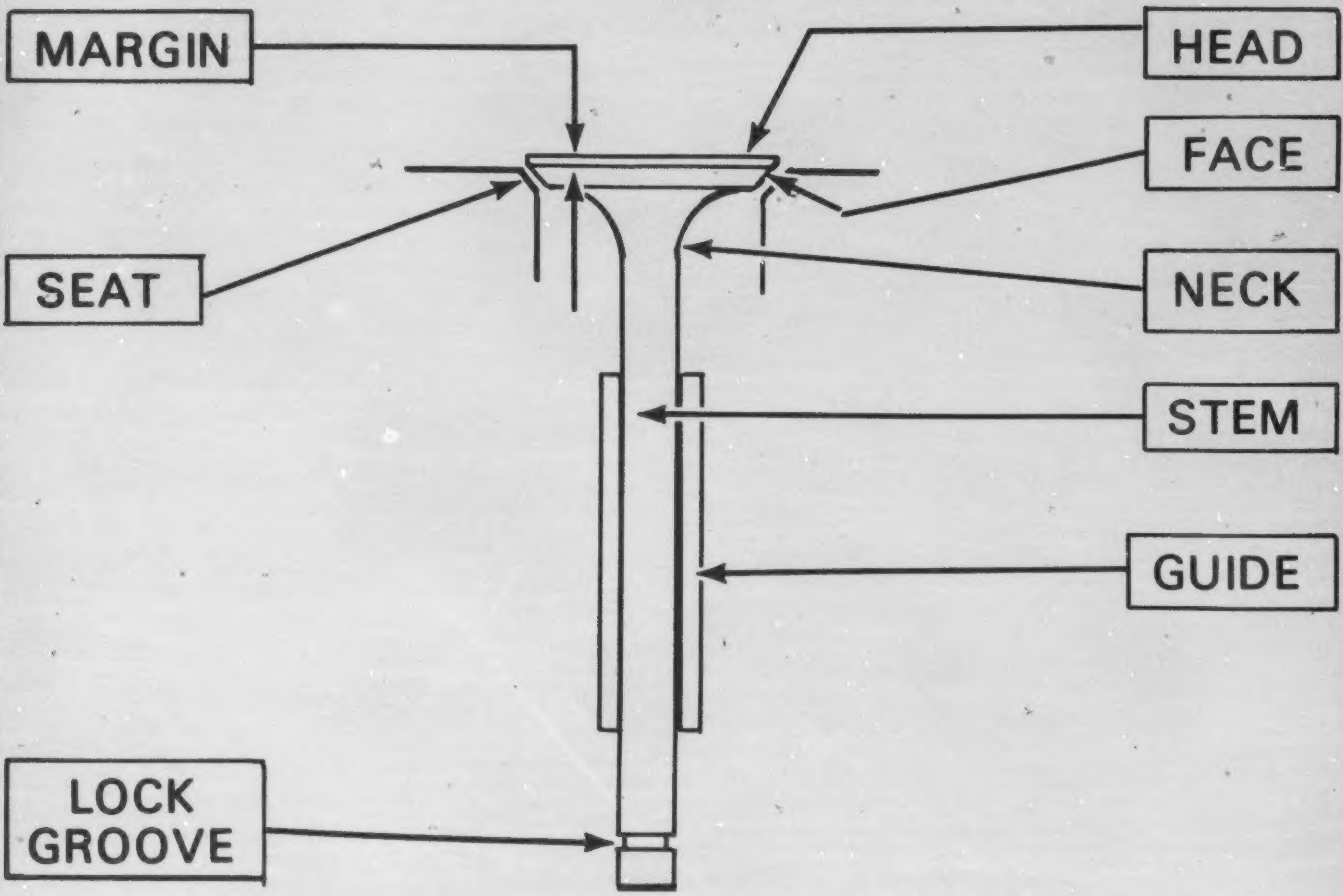
2 CYCLE ENGINE


FUEL, AIR AND OIL MIXTURE FROM CARBURETOR
REED VALVE OPEN

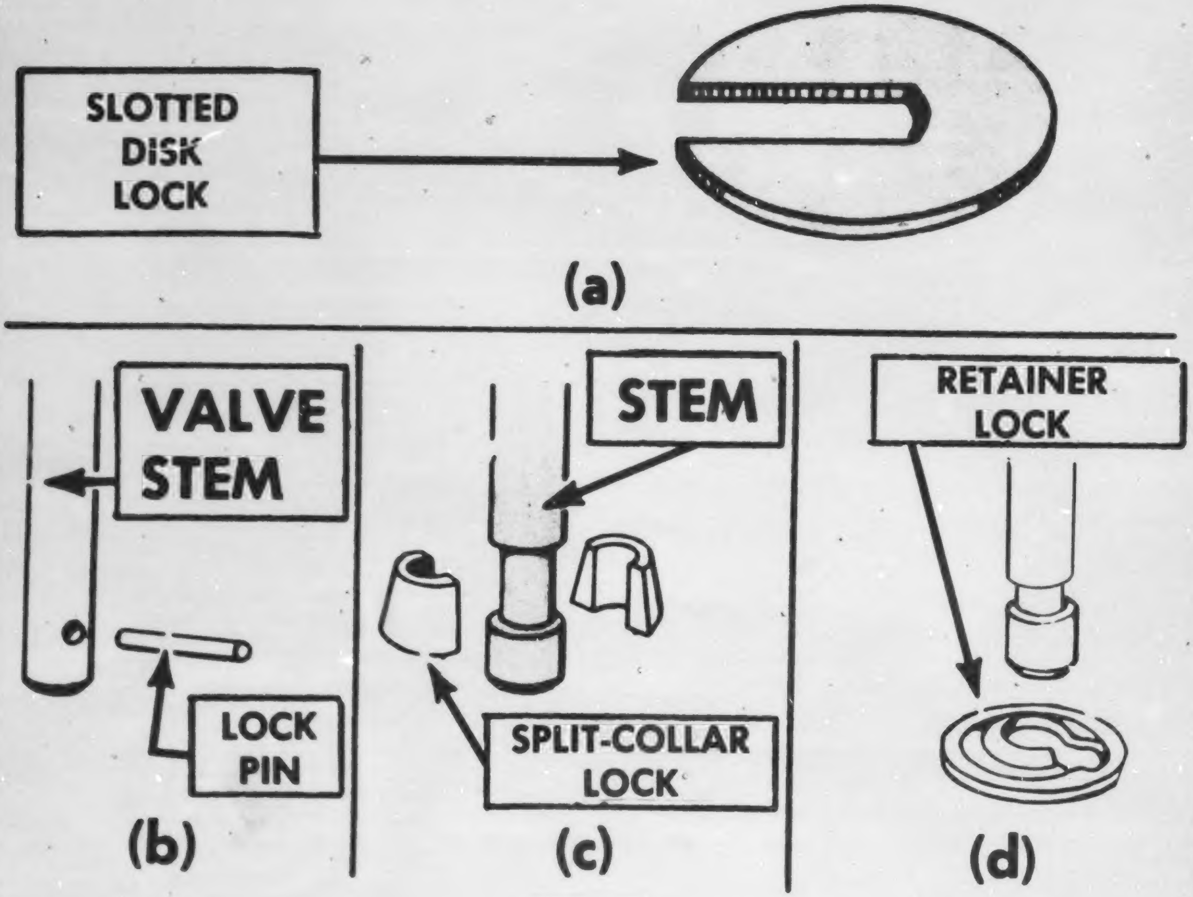
STROKE II — COMPRESSION

Piston moves upward, intake port closes. Exhaust port closes. Reed valve in crankcase opens. Fuel mixture is compressed in the cylinder.

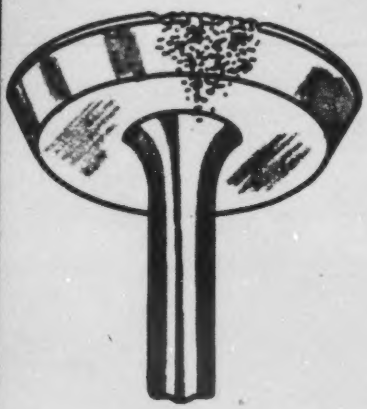
PARTS OF A VALVE


MARGIN
HEAD
FACE
SEAT
NECK
STEM
GUIDE
LOCK GROOVE

TYPES OF VALVE-SPRING RETAINER LOCKS

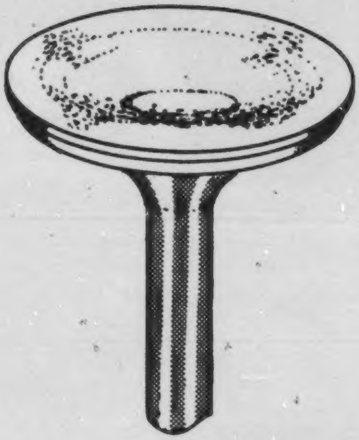

SLOTTED DISK LOCK
(a)
VALVE STEM
LOCK PIN
(b)
STEM
SPLIT-COLLAR LOCK
(c)
RETAINER LOCK
(d)

IMPROPERLY MAINTAINED VALVES



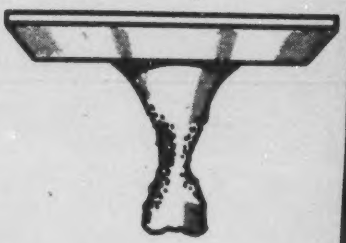
BURNED

(a)



DISHED

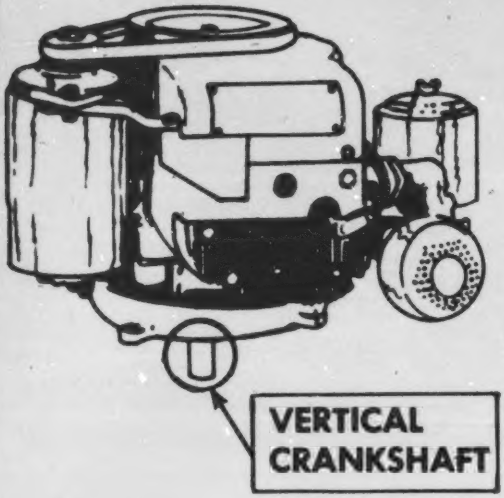
(b)

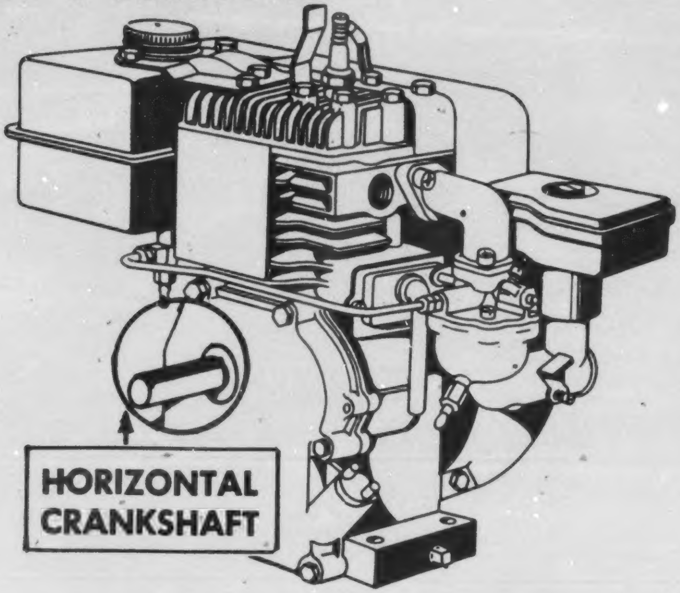


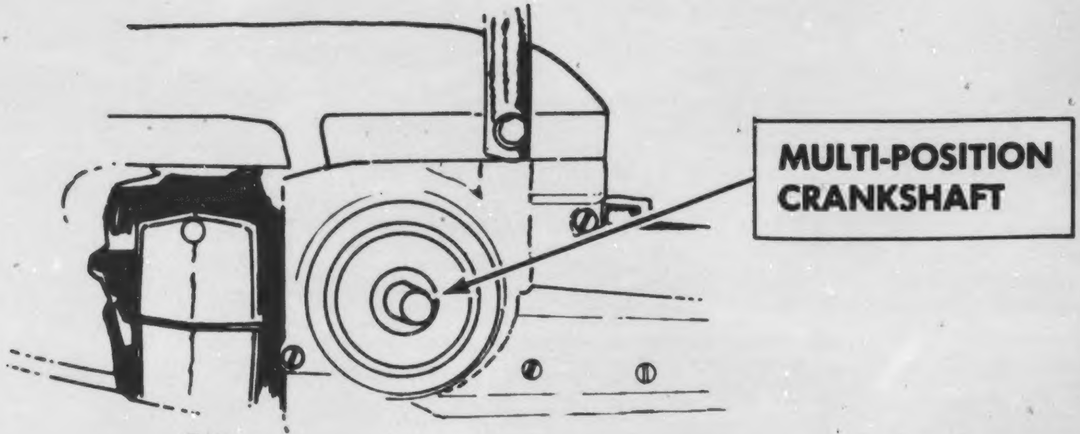
NECKED

(c)

DRIVE SHAFT POSITIONS


VERTICAL
CRANKSHAFT


HORIZONTAL
CRANKSHAFT


MULTI-POSITION
CRANKSHAFT

COMPRESSION

JOB SHEET #1-ENGINE INSPECTION CHART

Instructions: Complete this chart by inspecting a small gas engine provided by the instructor.

I. Engine: Make ____________________ Model ____________

Serial No. _____________ Horsepower ______

Specification No. __________________________

II. Engine cycle: 2-cycle __________ or 4-cycle ________

III. Operating position: Vertical______ Horizontal ____

IV. Carburetor air cleaner: Dry filter_________________,

Oil bath ________, or Oiled filter _________

V. Carburetor: Gravity ____, Suction ______,

or Diaphragm ____________

VI. Governor: Centrifugal _____, or Air vane _________

VII. Ignition system: Flywheel magneto ________________,

External magnet ___________, Solid state ___________,

or Battery _____________

VIII. Starter: Electric ________, Wind up _______________,

Rope-rewind ______, or Rope-Wind ________

COMPRESSION

JOB SHEET #2-DISASSEMBLE A SMALL GAS ENGINE

Instructions: Following correct procedure, disassemble a small gas engine provided by the instructor.

I. Secure the proper tools from the instructor.

II. Procedure for disassembly:

- A. Drain oil
- B. Remove air cleaner
- C. Remove gas line
- D. Remove carburetor and linkage with gas tank if attached
- E. Remove muffler
- F. Remove shroud and check rewind starter assembly
- G. Check compression
- H. Remove spark plug
- I. Check air gap, armature to flywheel
- J. Remove governor air vane
- K. Remove breather assembly (valve cover plate)
- L. Remove cylinder head and shield
- M. Check tappet clearance
- N. Remove valves and springs
- O. Remove starter pulley or starter clutch
- P. Remove flywheel
- Q. Remove breaker point cover
- R. Check contact point gap
- S. Remove points and check plunger hole
- T. Check end play

COMPRESSION

U. File burs and sand rust off crankshaft power take off end

V. Remove base or crankcase cover

W. Remove oil slinger and bracket

X. Remove cam gear

Y. Remove tappets

Z. Remove connecting rod and piston

AA. Remove crankshaft

BB. Test the condenser and coil

CC. Check cylinder bore, valve guides,and bearings

DD. Remove piston from connecting rod

EE. Check piston,rings, and piston pin

FF. Hone the cylinder

GG. Reface the valves

HH. Re-seat the valve seats

COMPRESSION

JOB SHEET #3-REASSEMBLE A SMALL GASOLINE ENGINE

Instructions: Following correct procedure, reassemble a small gas engine provided by the instructor.

I. Secure the proper tools from the instructor.

II. Procedure for reassembly:

   A. Replace the seals in the block and base

   B. Install the crankshaft

   C. Assemble piston pin and connecting rod

   D. Assemble the piston rings

   E. Install piston and connecting rod assembly

   F. Install tappets

   G. Install cam gear

   H. Install oil slinger, gear, and bracket

   I. Install base or crankcase cover with gasket

   J. Check and adjust end play

   K. Install fiber plunger, points, condenser, adjust cap, and clean

   L. Install point cover

   M. Install flywheel

   N. Install starter pulley or starter clutch

   O. Install governor air vane

   P. Adjust armature air gap

   Q. Check spark plugs

   R. Adjust valve tappet clearance

   S. Install valves, springs, and clearance

   T. Recheck valve tappet clearance

COMPRESSION

U. Install breather assembly (valve cover plate)

V. Install cylinder head and shield (torque head properly)

W. Test, clean, gap, and install spark plug

X. Check compression

Y. Install carburetor and linkage with gas tank if attached

Z. Check and align governor

AA. Install muffler

BB. Install shroud housing

CC. Fill in oil (check drain plug for tightness)

DD. Adjust carburetor

EE. Start engine

FF. Retighten cylinder head

GG. Make fine adjustments on carburetor

HH. Replace air cleaner

II. Paint engine

JJ. Apply decals

COMPRESSION

TEST

I. Match the correct terms with the proper definitions:

___A. Cylinder diameter

___B. Opens the valves and allows them to close by cams or lobes on the shaft.

___C. The process of burning.

___D. The reduction in volume or the "squeezing" of a gas.

___E. The volume of the combustion chamber at the end of the compression stroke as compared to the volume of the cylinder and the chamber with the piston on bottom center.

___F. Rod that connects the piston to the crankshaft.

___G. The main shaft of an engine which in conjunction with the connecting rods changes the reciprocating motion of the pistons into rotary motion.

___H. A round hole having some depth bored to receive a piston.

___I. A detachable portion of an engine fastened securely to the cylinder block which contains all or a portion of the combustion chamber.

___J. To regulate the flow of burnt gases from the cylinder and to aid in compression.

___K. A heavy wheel in which energy is absorbed and stored by means of momentum.

___L. Anything used as a packing, such as a non-metallic substance placed between two metal surfaces to act as a seal.

1. Bore
2. Camshaft
3. Combustion
4. Compression
5. Compression Ratio
6. Connecting Rod
7. Crankshaft
8. Cylinder
9. Cylinder Head
10. Exhaust Valve
11. Flywheel
12. Gasket
13. Governor
14. HP
15. Intake Valve
16. Piston
17. Piston Displacement
18. Piston Ring
19. Rod Cap
20. Spark Plug
21. Stroke
22. Trouble Shooting
23. Valve Clearance
24. Valve Lifter
25. Valve Spring

___M. A device to control and regulate speed. May be mechanical, hydraulic or electrical.

___N. Horsepower, the energy required to lift 550 lbs. 1 ft. in 1 second.

___O. To regulate the entering of air-fuel mixture and to hold it in the cylinder while it is compressed.

___P. A cylindrical part closed at one end which is connected to the crankshaft by the connecting rod. The force of the explosion in the cylinder is exerted against the closed end of the piston causing the connecting rod to move the crankshaft.

___Q. The volume of air moved or displaced by moving the piston from one end of its stroke to the other.

___R. An expanding ring placed in the grooves of the piston to provide a seal to prevent the passage of fluid or gas past the piston.

___S. To connect the connecting rod to the crankshaft.

___T. A device which extends into the combustion chamber that ignites the fuel and air mixture.

___U. The distance moved by the piston.

___V. Refers to a process of diagnosing or deducing the source of the trouble or troubles from observation and testing.

___W. The air gap allowed between the end of the valve stem and the valve lifter.

___X. A push rod or plunger between the cam and the valve on an engine.

___Y. Closes the valves.

II. Name and list the four principle events of a 4-cycle engine.

A.

B.

C.

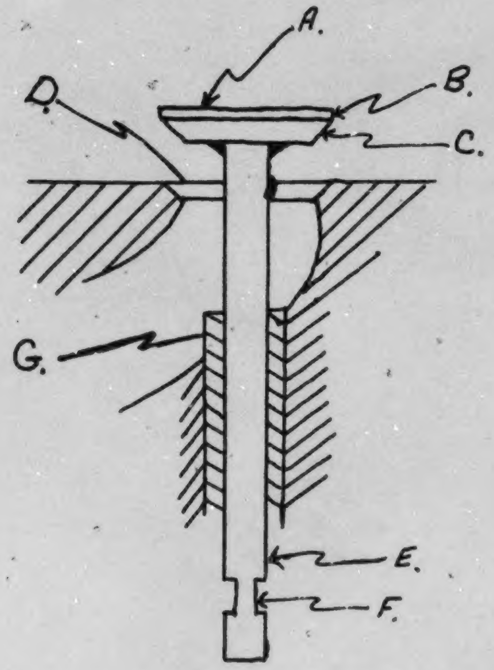
D.

III. Name and list the two principle events of a 2-cycle engine.

A.

B.

IV. Identify the seven parts of a valve.



A.

B.

C.

D.

E.

F.

G.

V. Name four types of valve spring locks.

A.

B.

C.

D.

VI. Name the three types of improperly maintained valves.

A.

B.

C.

VII. List six items of information that appear on name plates.

A.

B.

C.

D.

E.

F.

VIII. Name five advantages why small gas engines are so easily adapted to a job.

A.

B.

C.

D.

E.

IX. Name six different machines powered by small gas engines.

A.

B.

C.

D.

E.

F.

X. Write the formula and figure the piston displacement for an engine with a 2" bore and a 4" stroke using the formula for piston displacement.

XI. Name five parts of a piston.

A.

B.

C.

D.

E.

XII. List three types of piston rings.

A.

B.

C.

XIII. Name six types of oil distribution devices.

A.

B.

C.

D.

E.

F.

XIV. Name the three operating positions of small gas engines.

A.

B.

C.

XV. Demonstrate the ability to Trouble Shoot a compression problem set up by the instructor.

XVI. Demonstrate the ability to complete the information on an engine inspection chart.

XVII. Demonstrate the ability to disassemble a small gas engine

XVIII. Demonstrate the ability to reassemble a small gas engine.

COMPRESSION

ANSWERS TO TEST

I. A. 1
B. 2
C. 3
D. 4
E. 5
F. 6
G. 7
H. 8
I. 9
J. 10
K. 11
L. 12
M. 13
N. 14
O. 15
P. 16
Q. 17
R. 18
S. 19
T. 20
U. 21
V. 22
W. 23
X. 24

Y. 25

II. A. Intake - intake valve is open; exhaust valve is closed; piston is moving downward; and the fuel and air mixture is drawn into the cylinder through the intake valve opening.

B. Compression - both valves are closed; the piston moves up, compressing the fuel and air mixture.

C. Power - both valves are closed; the spark plug ignites the fuel and air mixture causing an explosion; the piston is forsed down exerting power to the crankshaft.

D. Exhaust - exhaust valve is open, the intake remains closed; the piston moves up forcing the burnt gases out through the exhaust valve opening; the exhaust valve closes; and the cycle is repeated.

III. A. Power, Exhaust, and Intake - the spark plug ignites the fuel, oil, and air mixture; piston moves down under pressure; reed valve is closed; piston moves past the exhaust port, the burnt gases escape; the piston moves past the intake port allowing the fuel, oil, and air mixture to enter the cylinder.

B. Compression - piston moves up closing off the intake and exhaust ports; the reed valve in the crankcase opens due to the vacuum created by the upward movement of the piston; the fuel, oil, and air mixture enters the crankcase; the fuel is compressed and the cycle is repeated.

IV. A. Head

B. Margin

C. Face

D. Seat

E. Stem

F. Lock Groove

G. Valve Guide

V. A. Pin

B. Split-Collar

C. Retainer

D. Slotted Disk

VI. A. Burned

B. Dished

C. Necked

VII. A. Make of Engine

B. Serial Number

C. Model Number

D. Size

E. R.P.M.

F. Specification Number

VIII. A. Lightweight

B. Air Cooled

C. Easy to Service

D. Compact

E. Self-Contained

IX. A. Lawn Mowers

B. Garden Tillers

C. Weed Eaters

D. Feed Grinders

E. Air Compressor

F. Elevators

(NOTE: Any number of machines would be sufficient.)

X. Piston Displacement = $\frac{(\text{Bore})^2}{4}$ X 3.1416 X Stroke

Piston Displacement = $\frac{(2")}{4}$ X 3.1416 X 4

Piston Displacement = 12.5664 cubic inches

XI. A. Piston Head
  B. Piston Lands
  C. Piston Pin
  D. Piston Ring Groove
  E. Piston Skirt

XII. A. Compression Rings
  B. Oil Scraping Rings
  C. Oil Control Rings

XIII. A. Dipper
  B. Dipper with Plunger
  C. Oil Scoop
  D. Oil Slinger
  E. Gear Pump
  F. Plunger Pump

XIV. A. Vertical
  B. Horizontal
  C. Multi-Position

XV. Performance skills to be evaluated by the instructor.

XVI. Performance skills to be evaluated by the instructor.

XVII. Performance skills to be evaluated by the instructor.

XVIII. Performance skills to be evaluated by the instructor.

UNIT II

IGNITION

IGNITION

TERMINAL OBJECTIVES

The student, upon completion of Unit II, should be able to; develop the ability to identify the parts and thier function in ignition, and to develop the skills of proper service of the ignition system of 4-cycle and 2-cycle engines. This knowledge will be evidenced through demonstration by scoring at least eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit of instruction, the student should be able to:

I. Match nine terms associated with ignition of a small gas engine.

II. List four types of starter assemblies.

III. Name three types of ignition systems.

IV. Name two types of magnetos.

V. Name seven parts of the primary winding.

VI. Name five parts of the secondary winding.

VII. List two types of breaker point opening mechanisms.

VIII. List seven principles of a magneto ignition system.

IX. List three heat ranges of spark plugs.

X. Name two types of governors.

XI. Trouble shoot any ignition problems on small gas engines.

XII. Demonstrate the ability to tune-up a small gas engine.

IGNITION

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with terminal and specific objectives, information sheets, and job sheets.

   B. Make transparencies.

   C. Discuss the information and job sheets and demonstrate procedures on the job sheets.

   D. Supply students with an engine with a faulty ignition system for them to trouble shoot the problem and repair.

   E. Give test.

II. Student:

   A. Study information sheets provided by the instructor.

   B. Complete job sheets and return to the instructor.

   C. Demonstrate the ability to perform the procedures on the job sheets.

   D. Demonstrate the ability to trouble shoot ignition problems on a small gas engine.

   E. Take test.

INSTRUCTIONAL MATERIALS

I. Materials included:

   A. Objectives

   B. Information sheets

   C. Transparency masters

      1. TM 1 - Types of Starter Assemblies (4)

      2. TM 2 - Types of Ignition Systems (3)

3. TM 3 - Breaker Point Opening Mechanisms (2)

4. TM 4 - Principles of a Magneto (3)

D. Job sheet

1. Job sheet #1 - Tune Up Of A Small Gas Engine

E. Test

F. Test answers

II. References:

A. Oklahoma Vocational Agriculture Education, Basic Core Curriculum III, Stillwater, Oklahoma, State Department of Vocational and Technical Education.

B. Briggs and Stratton Repair Instructions III, Milwaukee, Wisconsin, Briggs and Stratton Corp.

C. General Theories of Operation, Milwaukee, Wisconsin, Briggs and Stratton Corp.

D. Small Engines Care, Operation, Maintenance and Repair, Volume I, American Association for Vocational Instructional Materials.

E. Small Engines Maintenance and Repair, Volume II, American Association for Vocational Instructional Materials.

F. Jud Purvis, All About Small Gas Engines, The Goodheart Wilcox Co. Inc. 1963.

IGNITION

INFORMATION SHEET

I. Terms and definitions:

A. BREAKER POINTS - Breaks the flow of current in the primary circuit to flow through the secondary circuit sufficient to arc across the spark plug electrodes and produce a spark at the proper time.

B. COIL - Provides a conductor to surround the iron so voltage can be induced.

1. Primary Winding - Conducts voltage to the condenser.

2. Secondary Winding - Conducts voltage from coil to the spark plug.

C. CONDENSER - Serves as a reservoir of voltage and prevents arcing across the breaker points.

D. FLAT ON THE CRANKSHAFT - Raises and lowers the fiber plunger.

E. FLYWHEEL - Revolves the magnet and adds weight to the crankshaft for smooth operation of the engine.

F. FLYWHEEL MAGNET - Revolves inside the armature of the coil causing voltage to be produced.

G. FIBER PLUNGER - Opens and closes the breaker points.

H. SPARK PLUG - Provides spark during the compression stroke to ignite the fuel being compressed.

I. ARMATURE - Breaks the electrical force of the magnetic field, inducing voltage.

II. Four types of starter assemblies: TM 1

A. Rope-rewind starter

B. Vertical-pull, rope-rewind starter

C. Windup starter

D. Electric starter-generator

INFORMATION SHEET

III. Three types of ignition systems: TM 2

- A. Magneto - Produces its own electricity.
- B. Battery - May be recognized by the presence of an ignition coil, voltage regulator, and battery.
- C. Solid State - Receives power from a magneto-type alternator.

IV. Two types of magnetos:

- A. External type
- B. Flywheel type

V. Seven parts of the primary winding system:

- A. Battery*
- B. Ignition switch*
- C. Resistor*
- D. Primary coil winding
- E. Breaker points
- F. Condenser
- G. Low voltage wires

VI. Five parts of the secondary winding system:

- A. Secondary coil winding
- B. Distributor cap*
- C. Distributor rotor*
- D. Spark plug wires
- E. Spark plug

VII. Two types of breaker point opening mechanisms: TM 3

- A. Cam-operated

* Parts of a battery ignition system

INFORMATION SHEET

B. Push-rod operated

VIII. Seven principles of a magneto ignition system: TM 4

A. The magneto ignition system consists of two complete circuits, the primary and secondary.

B. As the rotating magnet on the flywheel turns, an electrical current is induced in the primary winding of the coil.

C. During this process, the points are closed.

D. After this current flows from the primary winding of the coil, it goes through the points to the ground terminal of the primary winding, concluding the first circuit.

E. The second circuit begins with the points open and a surge of voltage charges the condenser until the voltage in the condenser is greater than the voltage in the primary windings.

F. The voltage then reverses its direction of flow which changes the magnetic polarity of the magnet,completely collapsing the magnetic field.

G. This quick collapse of magnetic lines of force cut by many turns of the secondary windings induces a very high voltage in the secondary winding which goes to the spark plug center electrode, jumps through the ground electrode, and through the grounded terminal of the secondary winding.

IX. Three heat ranges of spark plugs:

A. Cold

B. Normal

C. Hot

X. Two types of governors:

A. Air vane

B. Centrifugal

INFORMATION SHEET

XI. Trouble shooting; Ignition

Symptom of trouble	Cause of improper function
A. Motor won't start or performs poorly.	A. Defective spark plug
B. Engine hard to start or performs poorly	B. Improper plug gap setting
	Wrong plug
	Incorrect point gap setting
	Burnt points
	Defective condenser
	Defective or shorted coil
	Loose lead wire
C. Poor performance, won't idle	C. Dirty plug because of too rich a fuel mixture
D. Plug won't fire, motor won't start	D. Cracked insulation
E. Out of time; motor may kick, hard to start	E. Worn key to put engine out of time
F. No fire or irregular firing	F. Incorrect armature air gap
	Worn bearings and/or shaft on flywheel side
	Sheared flywheel key
	Incorrect breaker point gap setting
	Dirty or burned breaker points
	Breaker plunger stuck or worn

INFORMATION SHEET

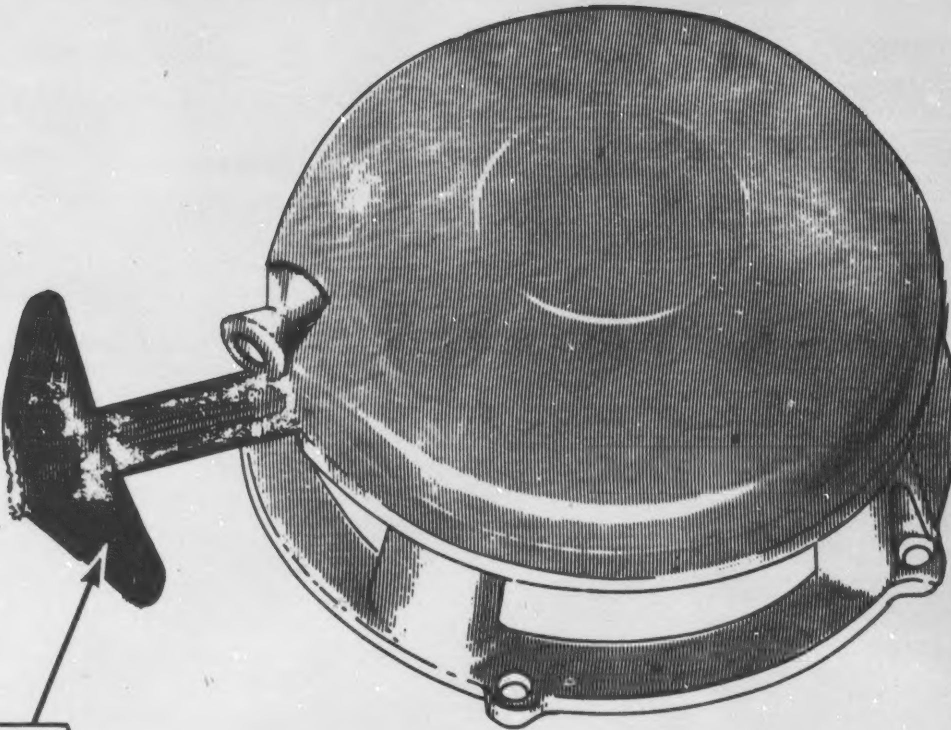
Shorted ground wire or stop switch

Condenser or armature failure

XII. Tune-up a small gas engine

A. The correct procedure for tune-up of a small gas engine is listed on job sheet #1. The participant must perform this job in order to complete this objective.

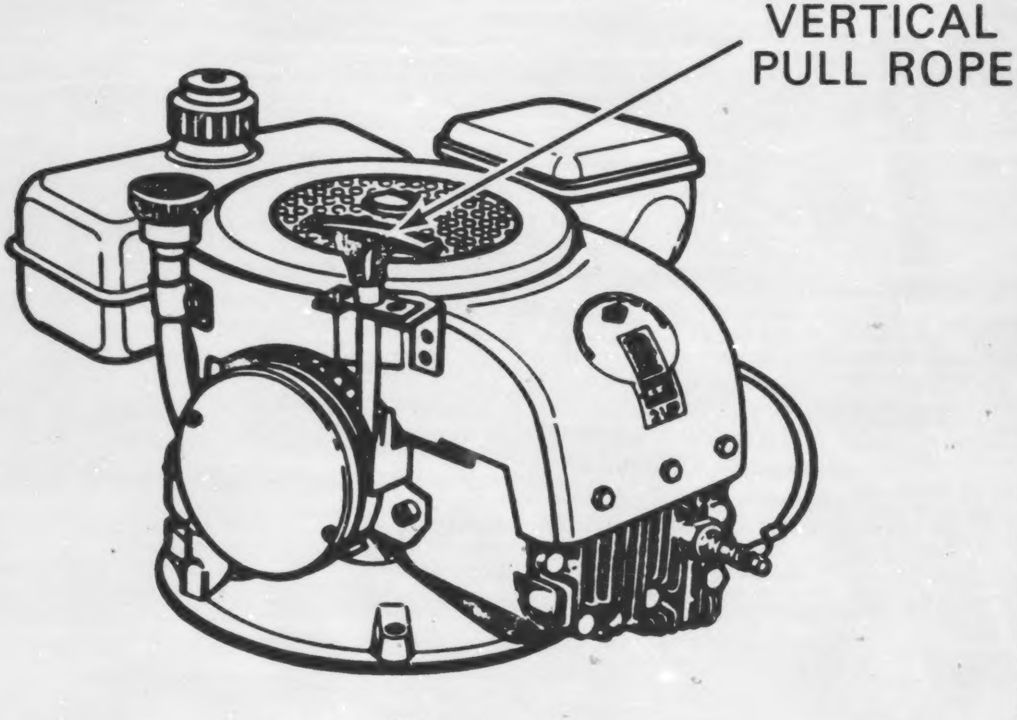
ROPE-REWIND STARTER



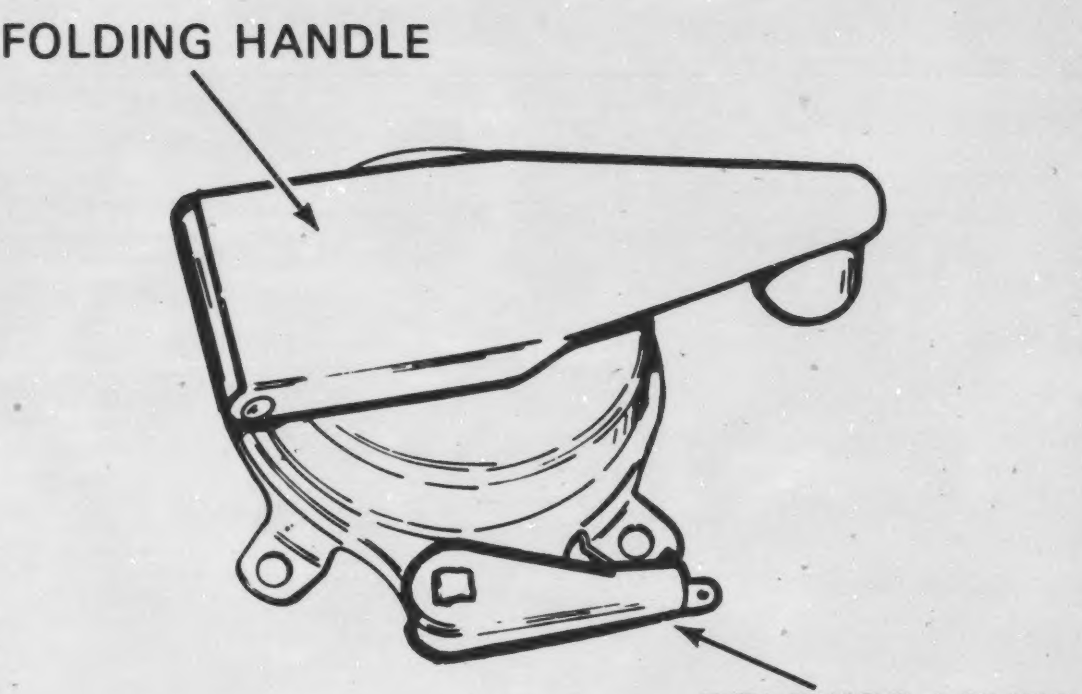
PULL HANDLE

57

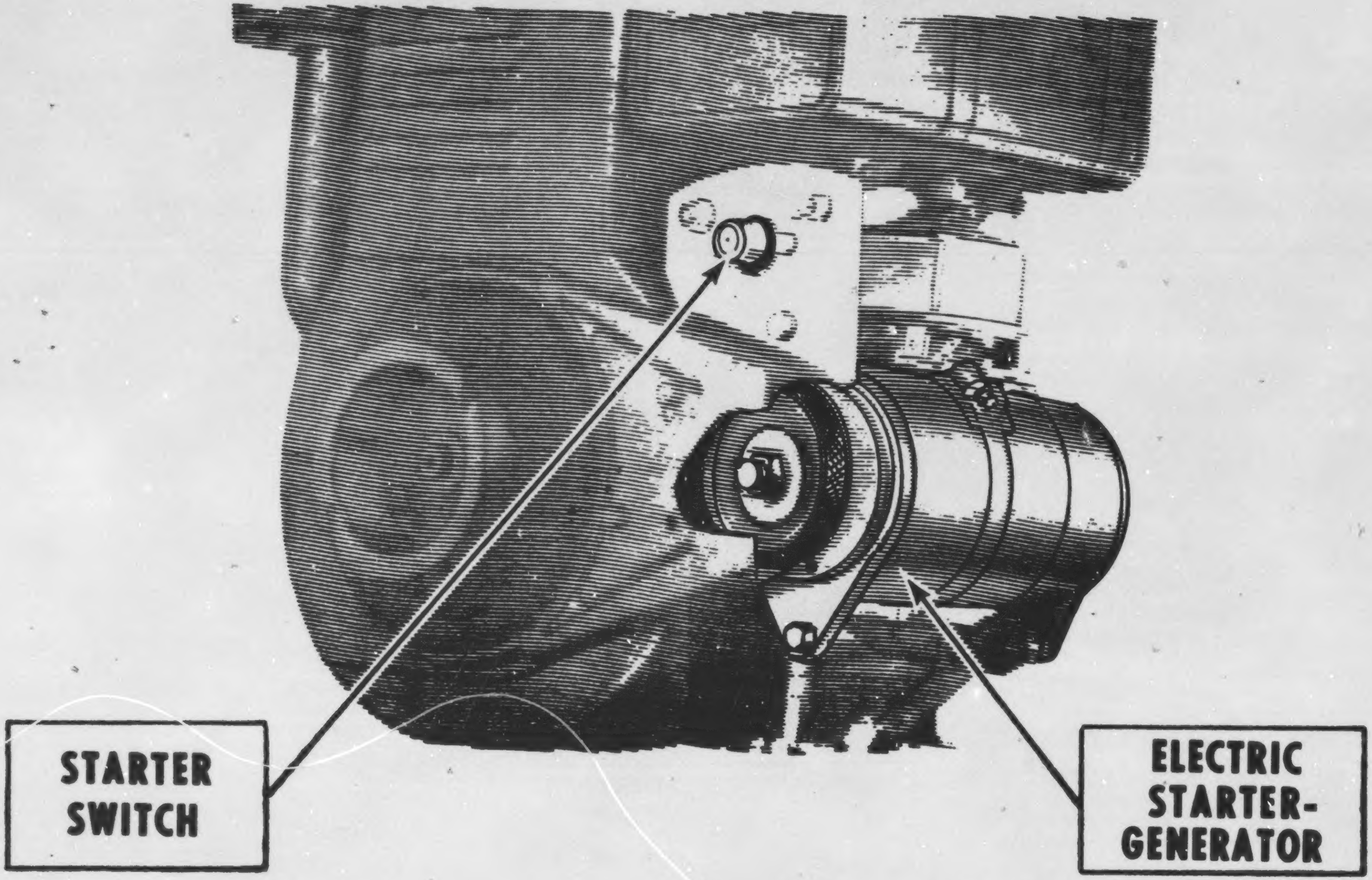
VERTICAL-PULL, ROPE-REWIND STARTER


VERTICAL
PULL ROPE

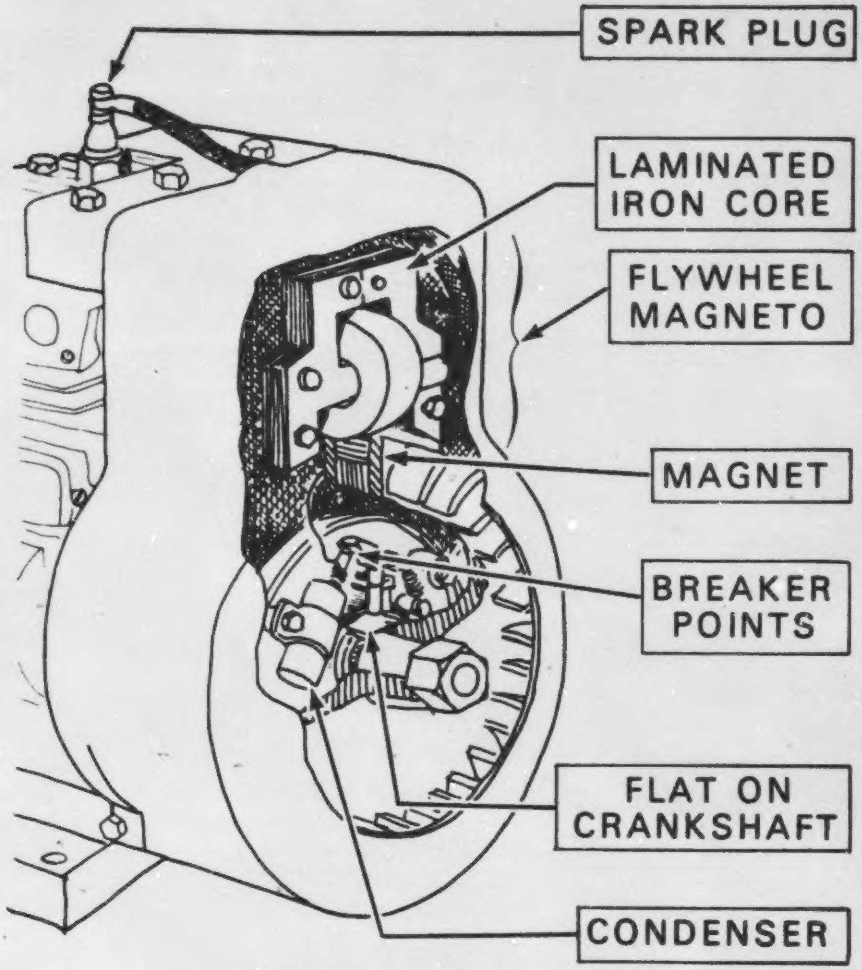
WINDUP STARTER


FOLDING HANDLE
RELEASE LEVER

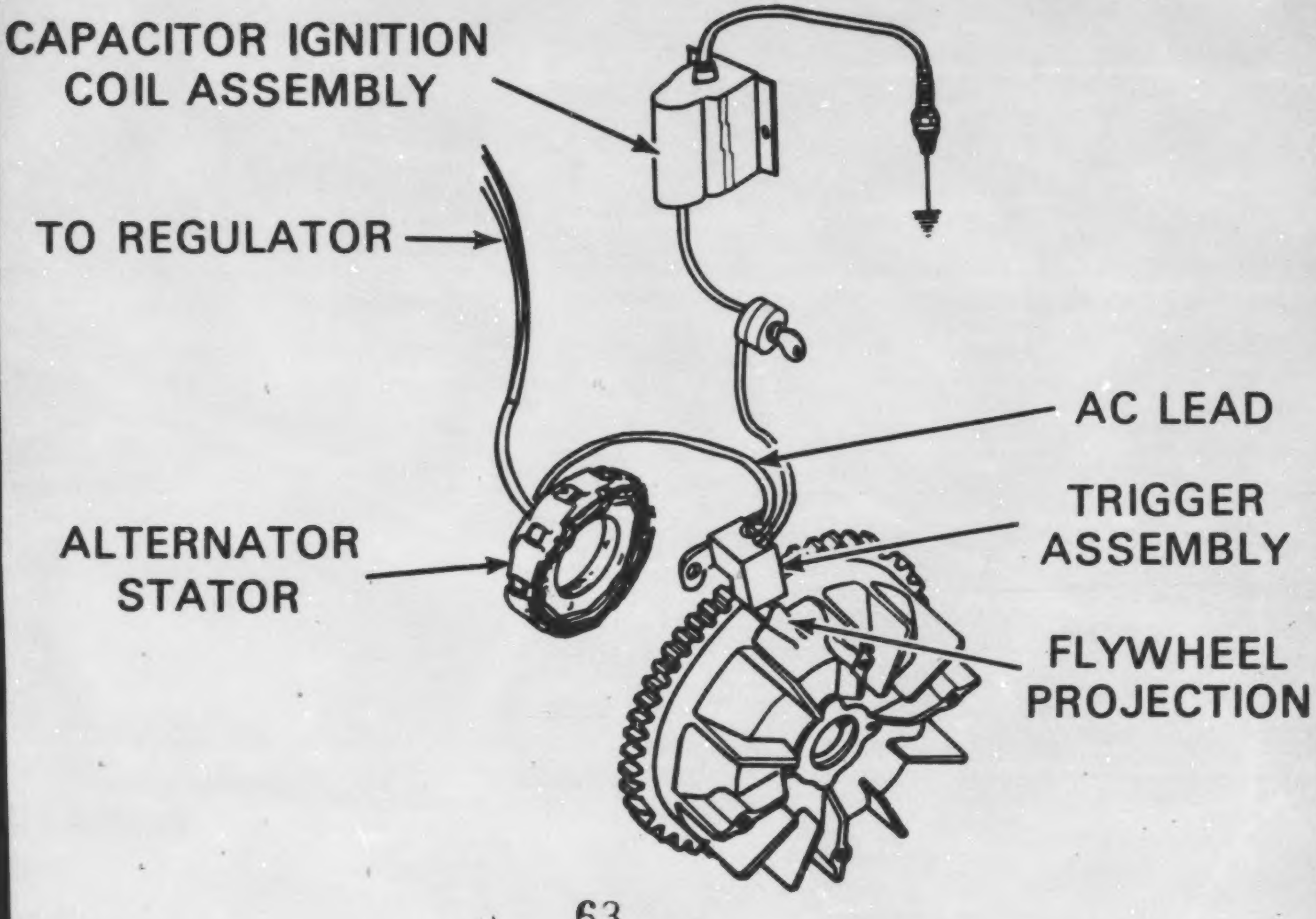
ELECTRIC STARTER-GENERATOR


STARTER SWITCH
ELECTRIC STARTER-GENERATOR

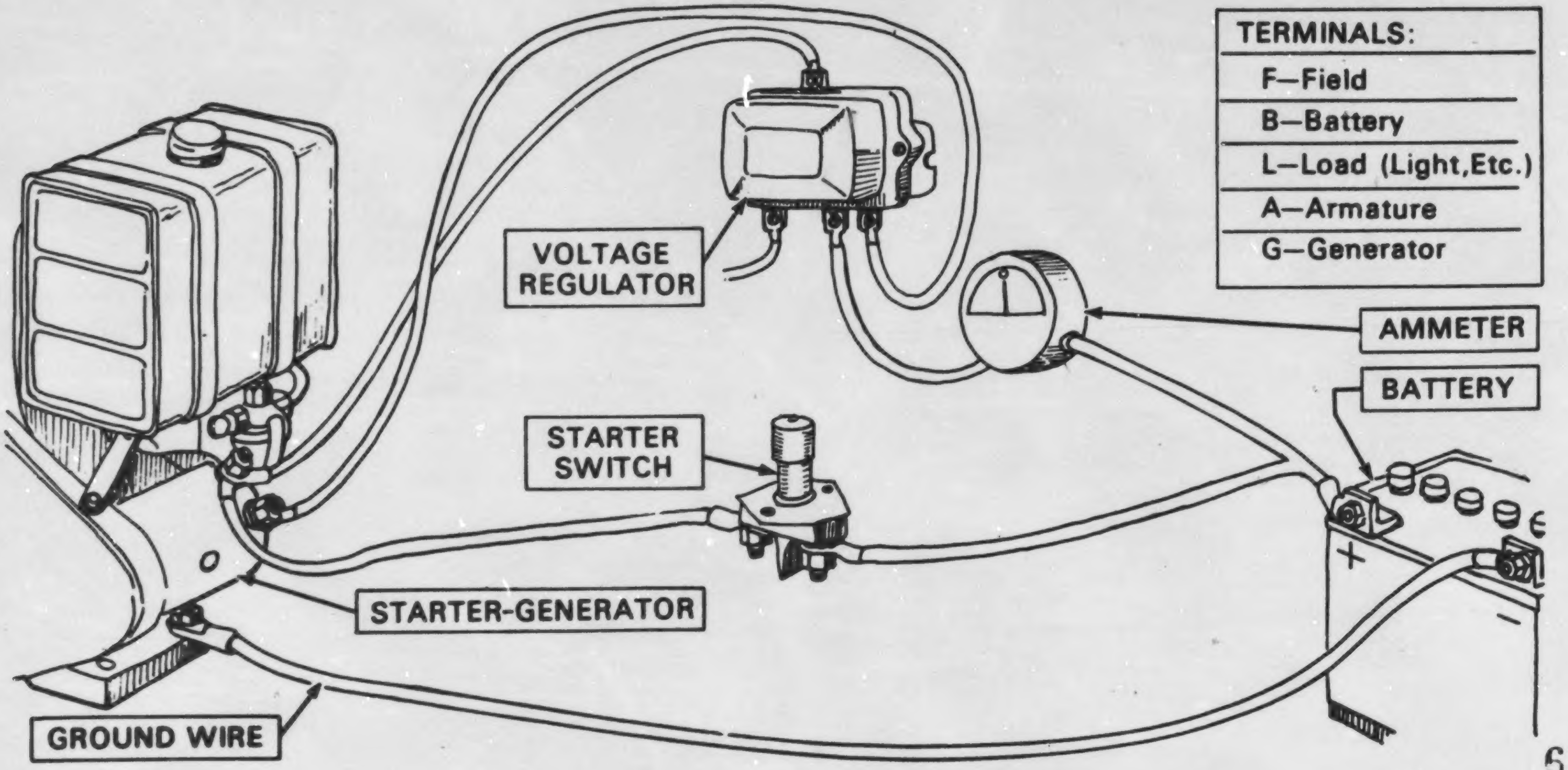
FLYWHEEL TYPE MAGNETO


SPARK PLUG
LAMINATED IRON CORE
FLYWHEEL MAGNETO
MAGNET
BREAKER POINTS
FLAT ON CRANKSHAFT
CONDENSER

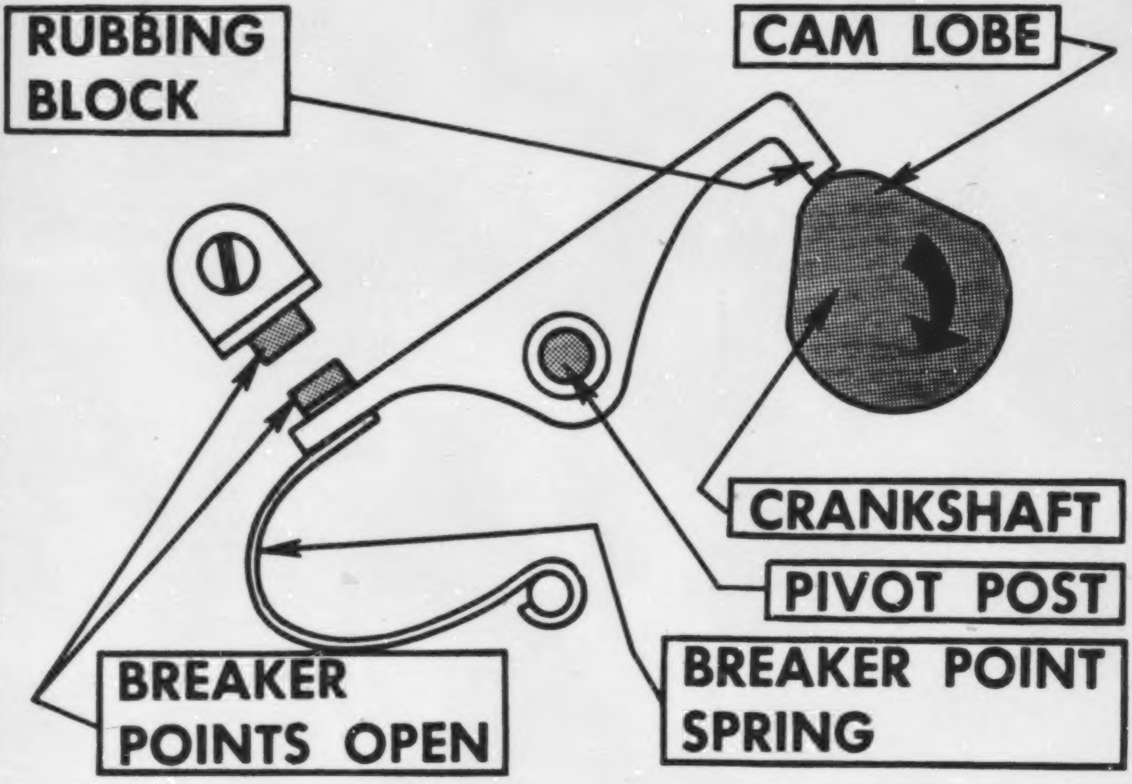
SOLID STATE IGNITION SYSTEM


CAPACITOR IGNITION COIL ASSEMBLY
TO REGULATOR
AC LEAD
TRIGGER ASSEMBLY
ALTERNATOR STATOR
FLYWHEEL PROJECTION

A 12-VOLT STARTER-GENERATOR SYSTEM

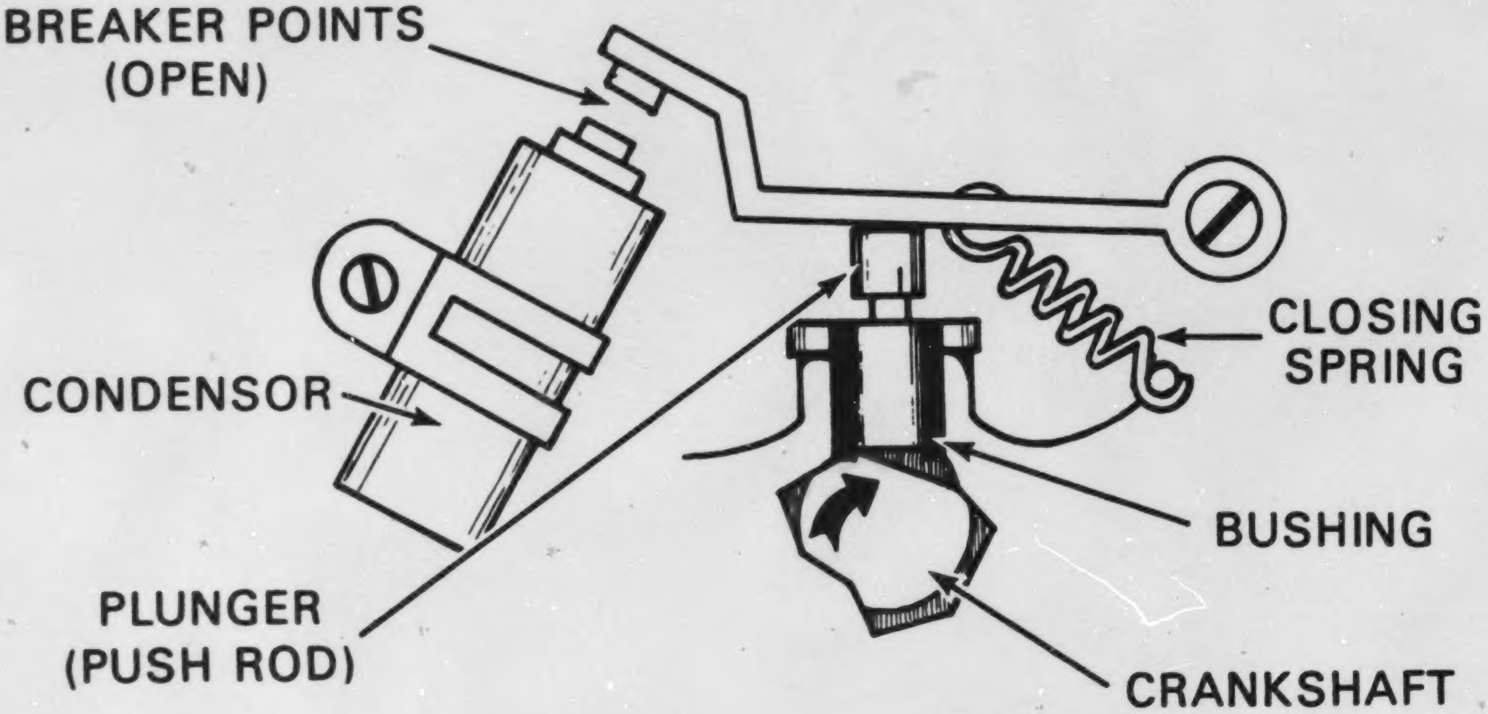

TERMINALS:
F—Field
B—Battery
L—Load (Light,Etc.)
A—Armature
G—Generator
VOLTAGE REGULATOR
AMMETER
BATTERY
STARTER SWITCH
+
−
STARTER-GENERATOR
GROUND WIRE

BREAKER-POINTS OPENING MECHANISM
(CAM-OPERATED)

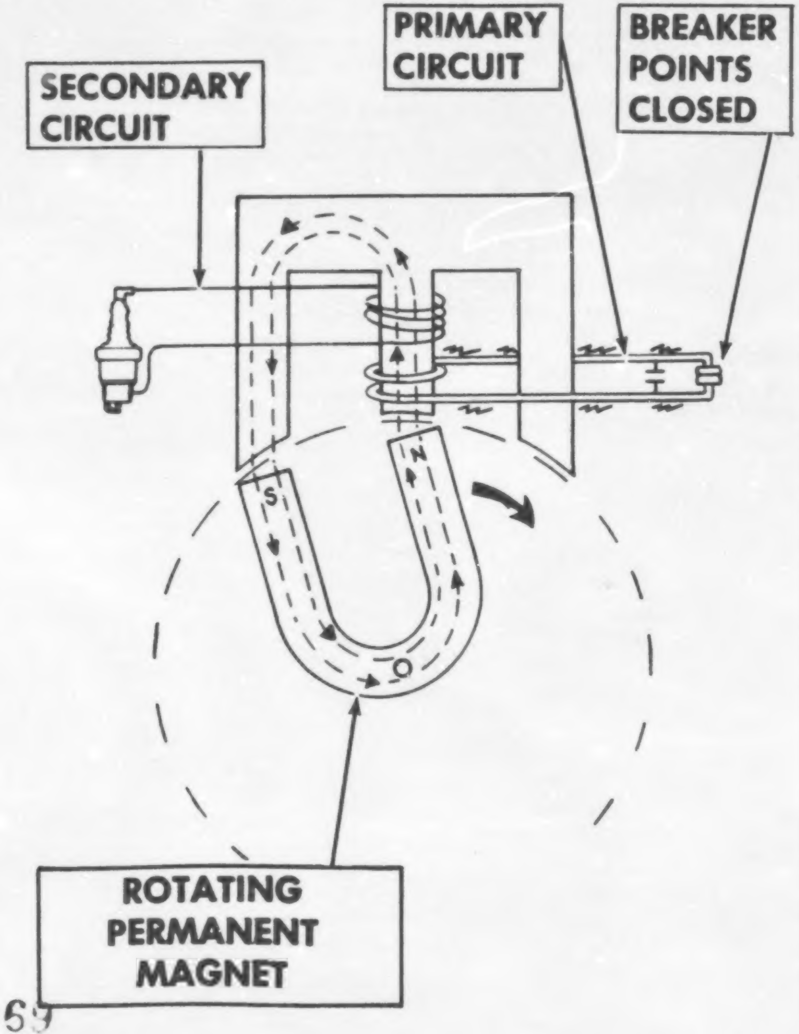

RUBBING BLOCK
CAM LOBE
CRANKSHAFT
PIVOT POST
BREAKER POINTS OPEN
BREAKER POINT SPRING

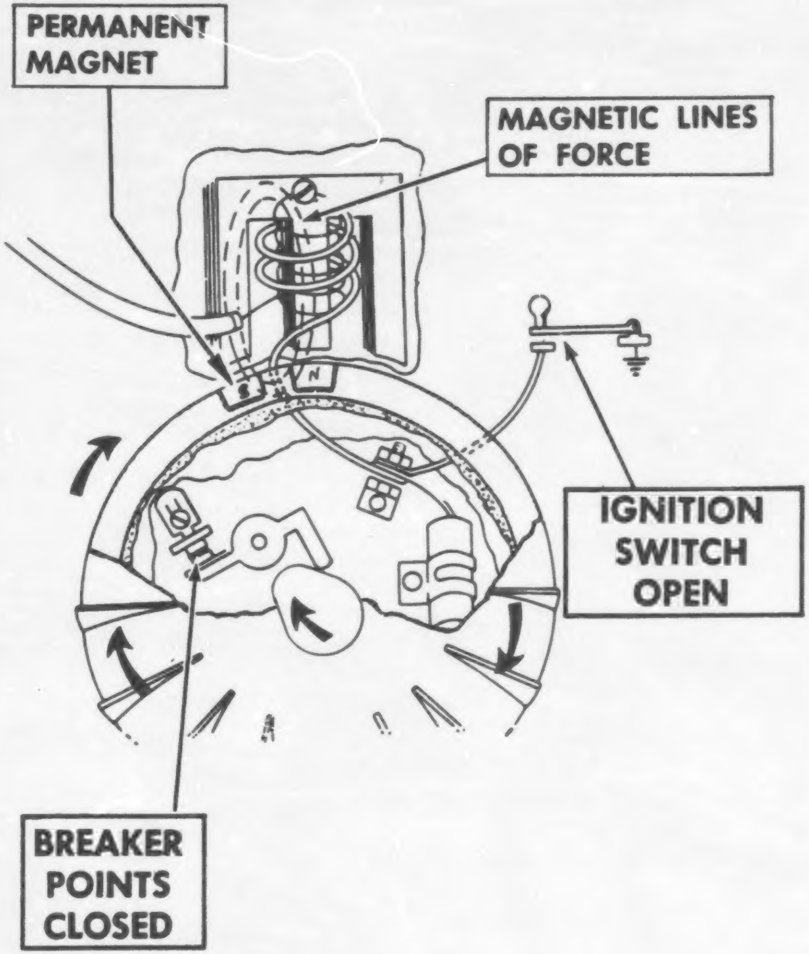
BREAKER-POINTS OPENING MECHANISM

(PUSH-ROD OPERATED)

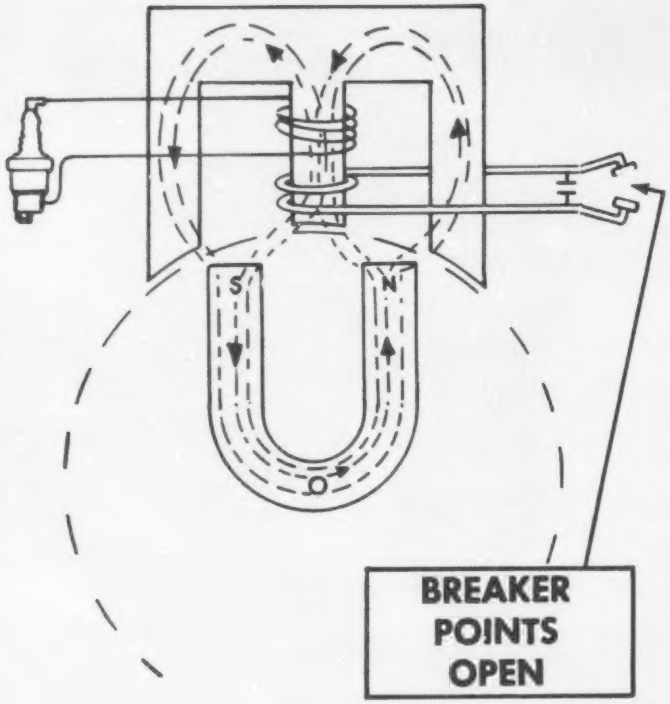

BREAKER POINTS (OPEN)
CONDENSOR
PLUNGER (PUSH ROD)
CLOSING SPRING
BUSHING
CRANKSHAFT

PRINCIPLES OF A MAGNETO

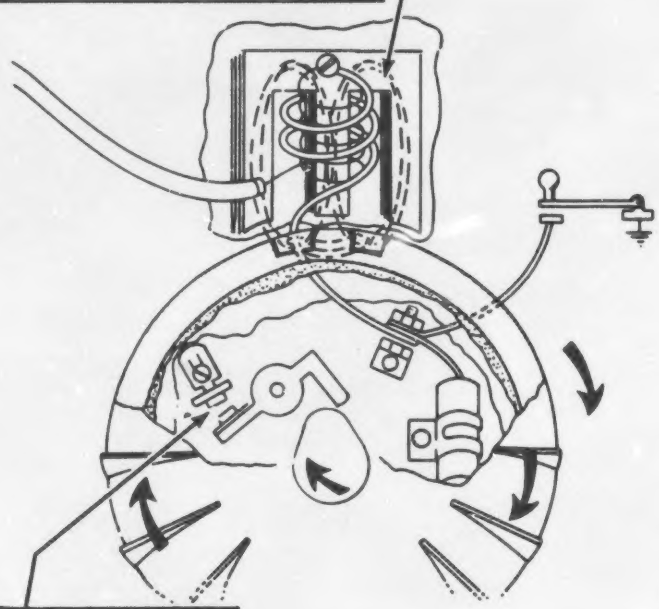

SECONDARY CIRCUIT
PRIMARY CIRCUIT
BREAKER POINTS CLOSED
S
N
ROTATING PERMANENT MAGNET


PERMANENT MAGNET
MAGNETIC LINES OF FORCE
S
N
IGNITION SWITCH OPEN
BREAKER POINTS CLOSED

PRINCIPLES OF A MAGNETO (CON'T)



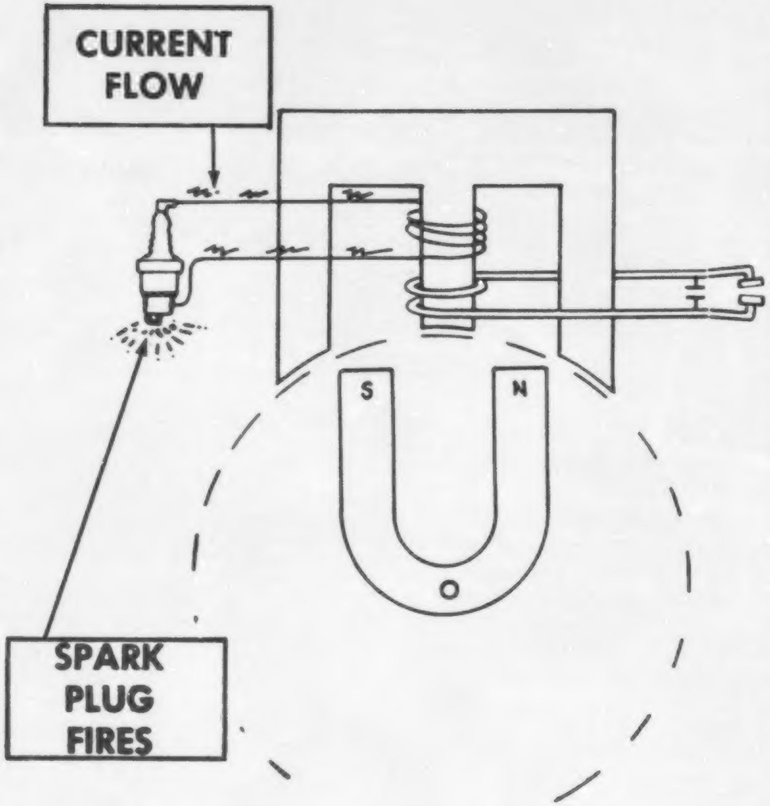
BREAKER POINTS OPEN



MAGNETIC LINES OF FORCE AT GREATEST STRENGTH

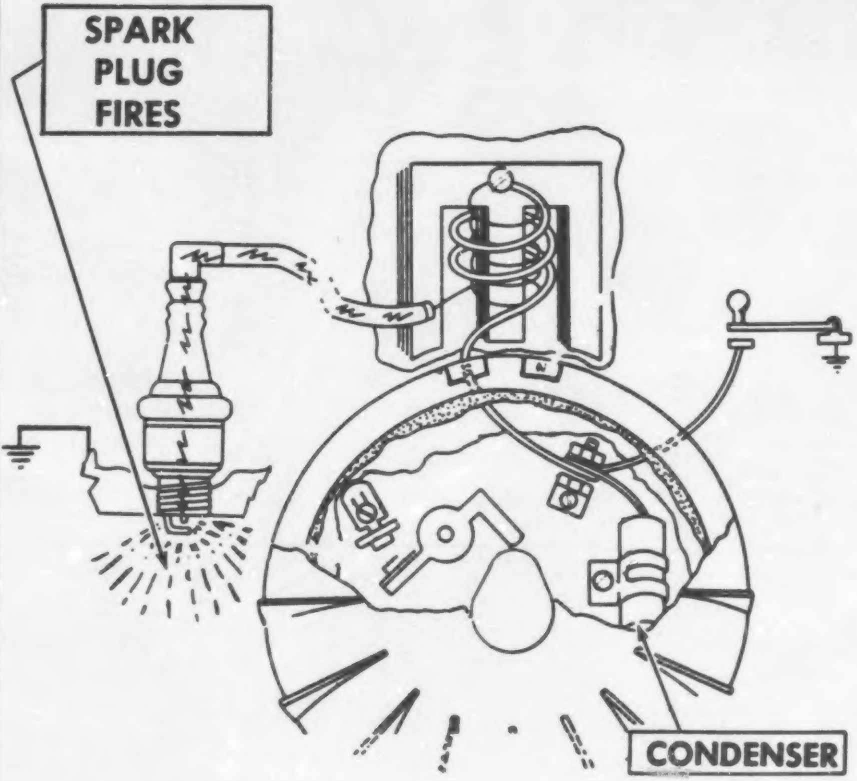
BREAKER POINTS OPEN

PRINCIPLES OF A MAGNETO (CON'T)



CURRENT FLOW

SPARK PLUG FIRES



SPARK PLUG FIRES

CONDENSER

IGNITION

JOB SHEET #1 - TUNE UP OF A SMALL GAS ENGINE

Following correct procedure, tune-up a small gas engine provided by the instructor.

I. Secure the proper tools from the instructor.

II. Procedure for tune-up:

   A. Remove air cleaner and check for improper service.

   B. Check oil level and drain.

   C. Clean cooling fins and check compression.

   D. Remove carburetor, check for wear and damaged parts. Clean in a solvent, replace parts if necessary and reassemble.

   E. Inspect intake elbow for damaged gaskets.

   F. Check governor blade, linkage and spring.

   G. Remove flywheel, check for seal leakage and damaged flywheel key.

   H. Remove breaker cover and inspect points and condenser, replace or clean and adjust. Check plunger.

   I. Check coil and all wires for damaged insulation.

   J. Replace breaker cover, use sealer where wires enter cover.

   K. Install flywheel, set air gap and check for spark.

   L. Remove spark plug, clean or replace with new plug.

   M. Replace blower assembly and starter clutch.

   N. Replace oil and fuel.

   O. Service air cleaner.

   P. Run and adjust mixture and top speed.

IGNITION

TEST

I. Match the correct term with the proper definition.

___A. Breaks the flow of current in the primary circuit to flow through the secondary circuit sufficient to arc across the spark plug at the proper time.

___B. Provides a conductor to surround the iron so voltage can be induced.

1. Breaker Points
2. Coil
3. Condenser
4. Flat on the Crankshaft
5. Flywheel
6. Flywheel Magnet
7. Fiber Plunger
8. Spark Plug
9. Armature

___C. Serves as a reservoir of voltage and prevents arcing across the breaker points.

___D. Raises and lowers the fiber plunger.

___E. Revolves the magnet and adds weight to the crankshaft for smooth operation of the engine.

___F. Revolves inside the armature of the coil causing voltage to be produced.

___G. Opens and closes the breaker points.

___H. Provides spark during the compression stroke to ignite the fuel being compressed.

___I. Breaks the electrical force of the magnetic field inducing voltage.

II. List four types of starter assemblies found on small gas engines.

A.

B.

C.

D.

III. Name three types of ignition systems.

A.

B.

C.

IV. Name two types of magnetos.

A.

B.

V. Name seven parts of the primary winding.

A.

B.

C.

D.

E.

F.

G.

VI. Name five parts of the secondary winding.

A.

B.

C.

D.

E.

VII. List two types of breaker point opening mechanisms.

A.

B.

VIII. List seven principles of a magneto ignition system.

A.

B.

C.

D.

E.

F.

G.

IX. List three heat ranges of spark plugs.

A.

B.

C.

X. Name two types of governors.

A.

B.

XI. Demonstrate the ability to trouble shoot an ignition problem set up by the instructor.

XII. Demonstrate the ability to tune-up a small gas engine.

IGNITION

ANSWERS TO TEST

I. A. 1
   B. 2
   C. 3
   D. 4
   E. 5
   F. 6
   G. 7
   H. 8
   I. 9

II. A. Rope-rewind starter
    B. Vertical-pull, rope-rewind starter
    C. Windup starter
    D. Electric starter generator

III. A. Magneto
     B. Battery
     C. Solid State

IV. A. External type
    B. Flywheel type

V. A. Battery
   B. Ignition switch
   C. Resistor
   D. Primary coil winding
   E. Breaker points

- F. Condenser
- G. Low voltage wires

VI.
- A. Secondary coil winding
- B. Distributor cap
- C. Distributor rotor
- D. Spark plug wires
- E. Spark plug

VII.
- A. Cam operated
- B. Push-rod operated

VIII.
- A. The magneto ignition system consists of two complete circuits, the primary and secondary.
- B. As the rotating magnet on the flywheel turns, an electrical current is induced in the primary winding of the coil.
- C. During this process, the points are closed.
- D. After this current flows from the primary winding of the coil, it goes through the points to the ground terminal of the primary winding, concluding the first circuit.
- E. The second circuit begins with the points open and a surge of voltage charges the condenser until the voltage in the condenser is greater than the voltage in the primary windings.
- F. The voltage then reverses its direction of flow which changes the magnetic polarity of the magnet, completely collapsing the magnetic field.
- G. This quick collapse of magnetic lines of force cut by many turns of the secondary windings induces a very high voltage in the secondary winding which goes to the spark plug center electrode, jumps through the ground electrode, and through the grounded terminal of the secondary winding.

IX. Three heat ranges of spark plugs:
- A. Cold

B. Normal

C. Hot

X. A. Air vane

B. Centrifugal

XI. To the satisfaction of the instructor.

XII. To the satisfaction of the instructor.

UNIT III

CARBURETION

CARBURETION

TERMINAL OBJECTIVE

The student, upon completion of Unit III, should be able to, develop the ability to identify the parts and thier function in carburetion, and develop skills of proper service of the carburetion system of 4-cycle and 2-cycle engines. This knowledge will be evidenced through demonstrtion and by scoring at least eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the students should be able to:

I. Match twelve terms associated with carburetion of a small gas engine.

II. Name three types of carburetors on small gas engines.

III. Name four types of fuel filters found on small gas engines.

IV. List three different types of air cleaners.

V. Trace the fuel from the gas tank to cylinder.

VI. List three types of engine cleaning solutions.

VII. List four steps in adjusting the carburetor on a small gas engine.

VIII. List the purpose of lubricants.

IX. Demonstrate the ability to trouble shoot a carburetion problem on small gas engines.

X. Service an oil-bath air cleaner.

XI. Service an oil-filter air cleaner.

XII. Service a dry-filter air cleaner.

XIII. Service a sediment bowl and fuel filter.

CARBURETION

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with the terminal and specific objectives, information sheets and job sheets.

   B. Make transparencies.

   C. Discuss information and procedures on job sheets.

   D. Supply an engine for students with a carburetion failure for them to trouble shoot the problem and repair or adjust.

   E. Give test.

II. Student:

   A. Study information sheets.

   B. Complete job sheets.

   C. Demonstrate the ability to perform the procedures on the job sheets.

   D. Demonstrate the ability to trouble shoot carburetion problems on the small gas engines.

   E. Take test.

INSTRUCTIONAL MATERIALS

I. Materials included:

   A. Objectives

   B. Information sheets

   C. Transparency masters

      1. TM 1 - Types of Carburetors (4)

      2. TM 2 - Types of Fuel Filters (4)

      3. TM 3 - Types of Air Cleaners (3)

4. TM 4 - Crankcase Oil Recommendations (1)

D. Job Sheets

1. Job sheet #1 - Servicing An Oil-Bath Air Cleaner

2. Job sheet #2 - Servicing An Oil-Filter Air Cleaner

3. Job sheet #3 - Servicing A Dry-Filter Air Cleaner

4. Job sheet #4 - Servicing A Sediment Bowl and Fuel Filter

E. Test

F. Test answers

II. References:

A. Oklahoma Vocational Agriculture Education, Basic Core Curriculum III, Stillwater, Oklahoma, State Department of Vocational and Technical Education. 1

B. Briggs and Stratton Repair Instructions III, Milwaukee, Wisconsin, Briggs and Stratton Corp.

C. General Theories of Operation, Milwaukee, Wisconsin, Briggs and Stratton Corp.

D. Small Engines Care, Operation, Maintenance and Repair, Volume I, American Association for Vocational Instructional Materials.

E. Small Engines Maintenance and Repair, Volume II, American Association for Vocational Instructional Materials.

F. Jud Purvis, All About Small Gas Engines, The Goodheart Wilcox Co. Inc., 1963.

CARBURETION

INFORMATION SHEET

I. Terms and definitions:

A. AIR CLEANER - A device for filtering, cleaning and removing dust from the air entering the engine.

B. CARBURETOR - A device for automatically mixing fuel in the proper proportion with air to produce a combustible gas.

C. CARBURETOR BOWL - A reservoir for gas before being used by the motor and to maintain a sufficient supply available.

D. CHOKE - A device that restricts the volume of air admitted into the carburetor, which allows a raw mixture of gas to enter the cylinder for easy starting.

E. FLOAT - A hollow tank that is lighter than the gas which forces the float needle valve into the seat and stops the gas flow when the bowl is full.

F. FLOAT NEEDLE VALVE - Stops the gas flow into the carburetor when the bowl is full.

G. GOVERNOR - A device to control and regulate the speed of an engine.

H. GUM - Refers to the oxidized petroleum products which accumulate in the fuel system.

I. IDLE - Refers to the engine operating at its slowest speed.

J. NEEDLE VALVE - Regulates the gas flow into the nozzle.

K. THROTTLE - Regulates the gas flow to get different speeds.

L. VENTURI - Causes gas to spray from the nozzle.

II. Three types of carburetors on small gas engines: TM 1

A. Gravity type

B. Suction type

INFORMATION SHEET

C. Diaphram type

III. Four types of fuel filters: TM 2

A. Combination sediment bowl and screen

B. Screen in fuel tank

C. Inline filter screen

D. Strainer on fuel pick-up hose

IV. Three types of air cleaners: TM 3

A. Oil-bath

B. Oil-filter

C. Dry-filter

V. Tracing the fuel from the gas tank to cylinder:

A. Gas tank-- B. Gas line-- C. Float needle valve--

D. Float needle seat-- E. Carburetor bowl--

F. Nozzle-- G. Venturi-- H. Throat-- I. Intake manifold-- J. Intake valve-- K. Cylinder.

VI. Three types of engine cleaning solutions:

A. Steam

B. Petroleum solvents

1. Kerosene

2. Varosole

3. Diesel

C. Commercial degreasers

VII. Adjusting the carburetor for maximum power:

A. Run engine at operating speed.

B. Turn the needle valve in until the engine slows down.

INFORMATION SHEET

C. Then turn the needle valve out until the engine speeds up and slows down.

D. Turn the valve back again to a point half-way between these two points.

VIII. List the purpose of lubricants: TM 4

A. To reduce internal friction in order to:

1. Obtain more useful horsepower.

2. To reduce operating temperature.

IX. Trouble shooting carburetion:

Symptom of trouble	Cause of improper function
A. Air cleaner clogged to prevent proper flow of air.	A. Clogged with foreign matter.
B. Engine stalls when under load and speed difficult to control.	B. Governor out of adjustment.
C. Gas will not flow from tank.	C. Stopped up gas cap hole.
D. When line is loosened at carburetor and gas does not flow freely.	D. Stopped up gas line.
E. Gas does not flow to carburetor.	E. Filter screen needs cleaning.
F. Flooding or lack of gas.	F. Float not properly adjusted. Hole in the float. Float needle valve not properly seated.
G. Motor hard to turn and keep adjusted.	G. Taper or needle valve or idle valve worn.
H. Motor does not perform properly when throttling or choking.	H. Worn shaft or bushing on throttle control.

INFORMATION SHEET

X. Service an oil-bath air cleaner.

A. The correct procedure for servicing an oil-bath air cleaner is listed on job sheet #1. The participant must perform this job in order to complete this objective.

XI. Service an oil-filter air cleaner.

A. The correct procedure for servicing an oil-filter air cleaner is listed on job sheet #2. The participant must perform this job in order to complete this objective.

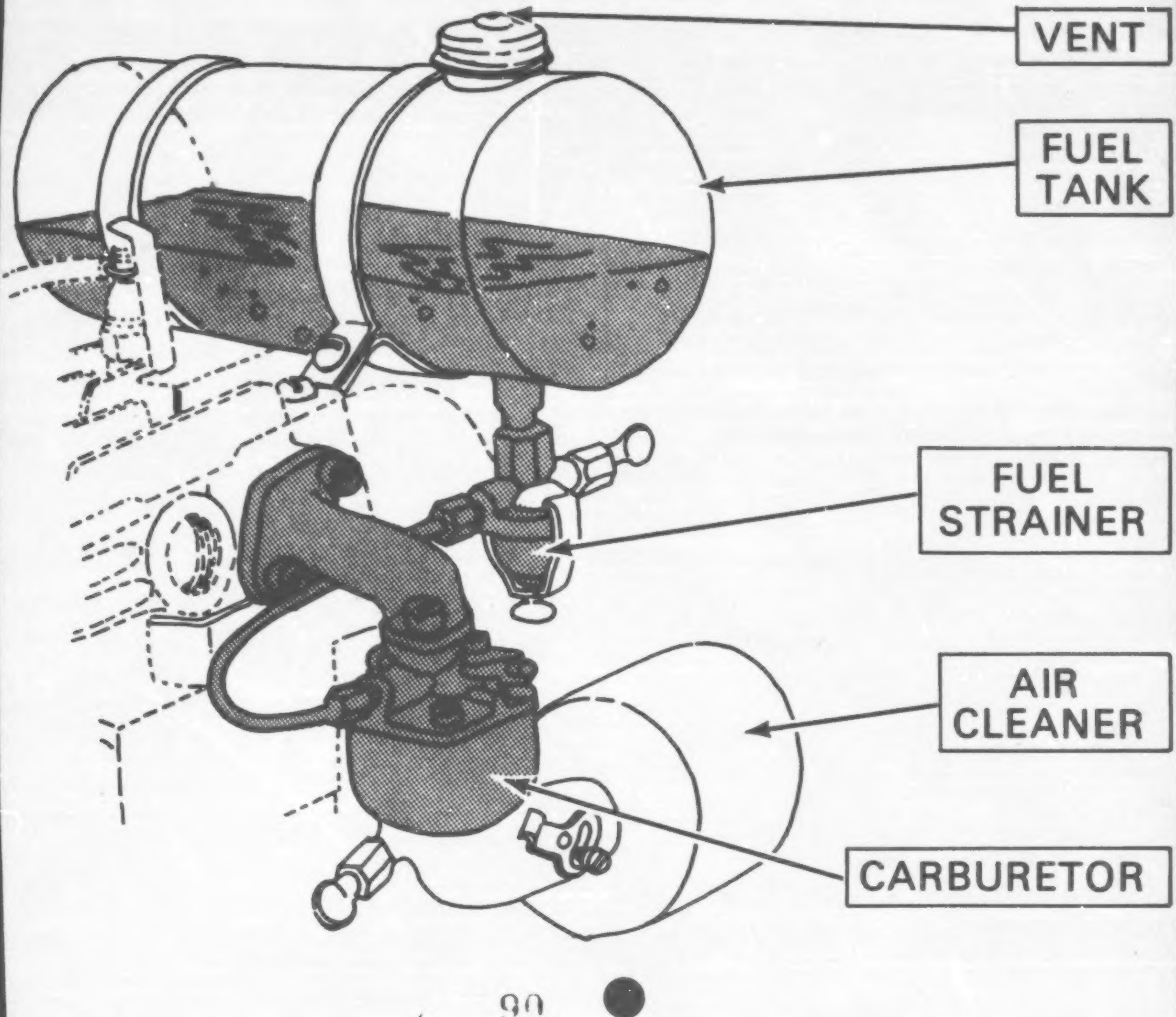
XII. Service a dry-filter air cleaner.

A. The correct procedure for servicing a dry-filter air cleaner is listed on job sheet #3. The participant must perform this job in order to complete this objective.

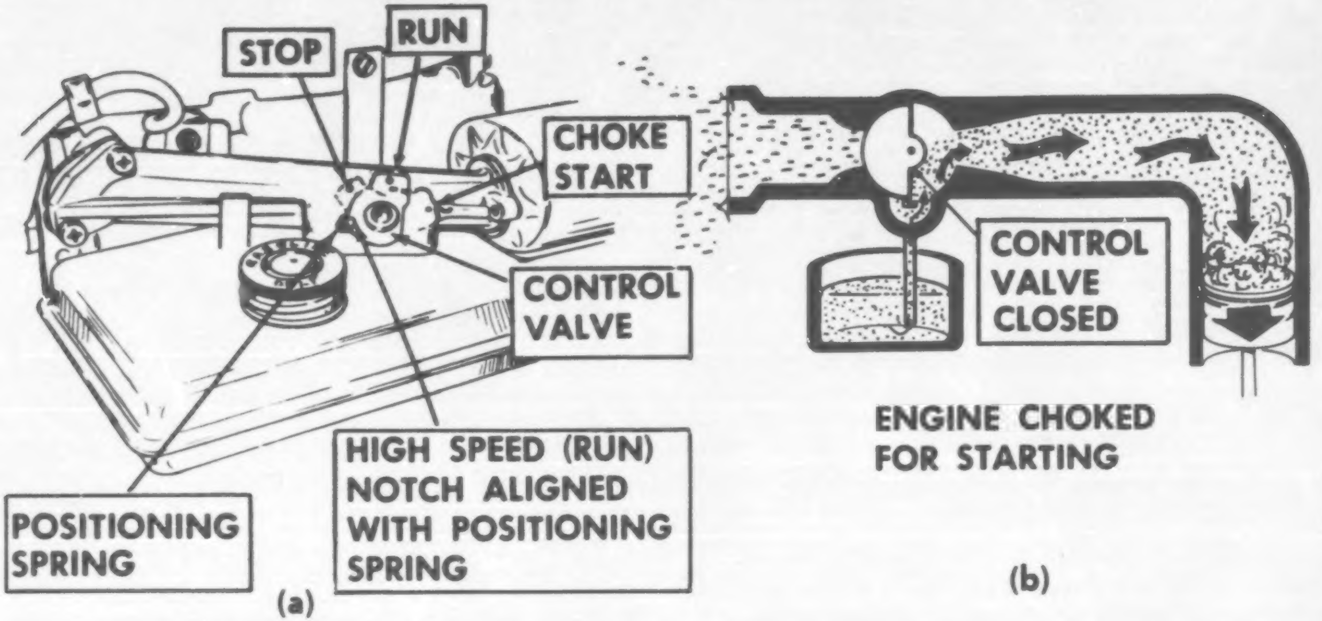
XIII. Service a sediment bowl and fuel filter.

A. The correct procedure for servicing a sediment bowl and fuel filter is listed on job sheet #4. The participant must perform this job in order to complete this objective.

GRAVITY-FEED FUEL SYSTEM

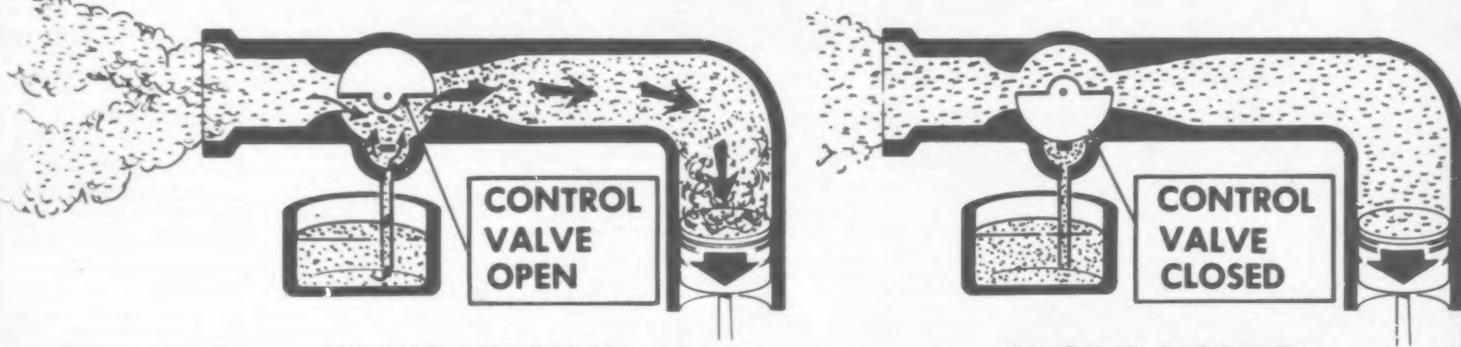

VENT
FUEL TANK
FUEL STRAINER
AIR CLEANER
CARBURETOR

SUCTION-LIFT TYPE CARBURETOR


STOP
RUN
CHOKE START
CONTROL VALVE
POSITIONING SPRING
HIGH SPEED (RUN) NOTCH ALIGNED WITH POSITIONING SPRING
(a)
CONTROL VALVE CLOSED

ENGINE CHOKED FOR STARTING

(b)


CONTROL VALVE OPEN
CONTROL VALVE CLOSED

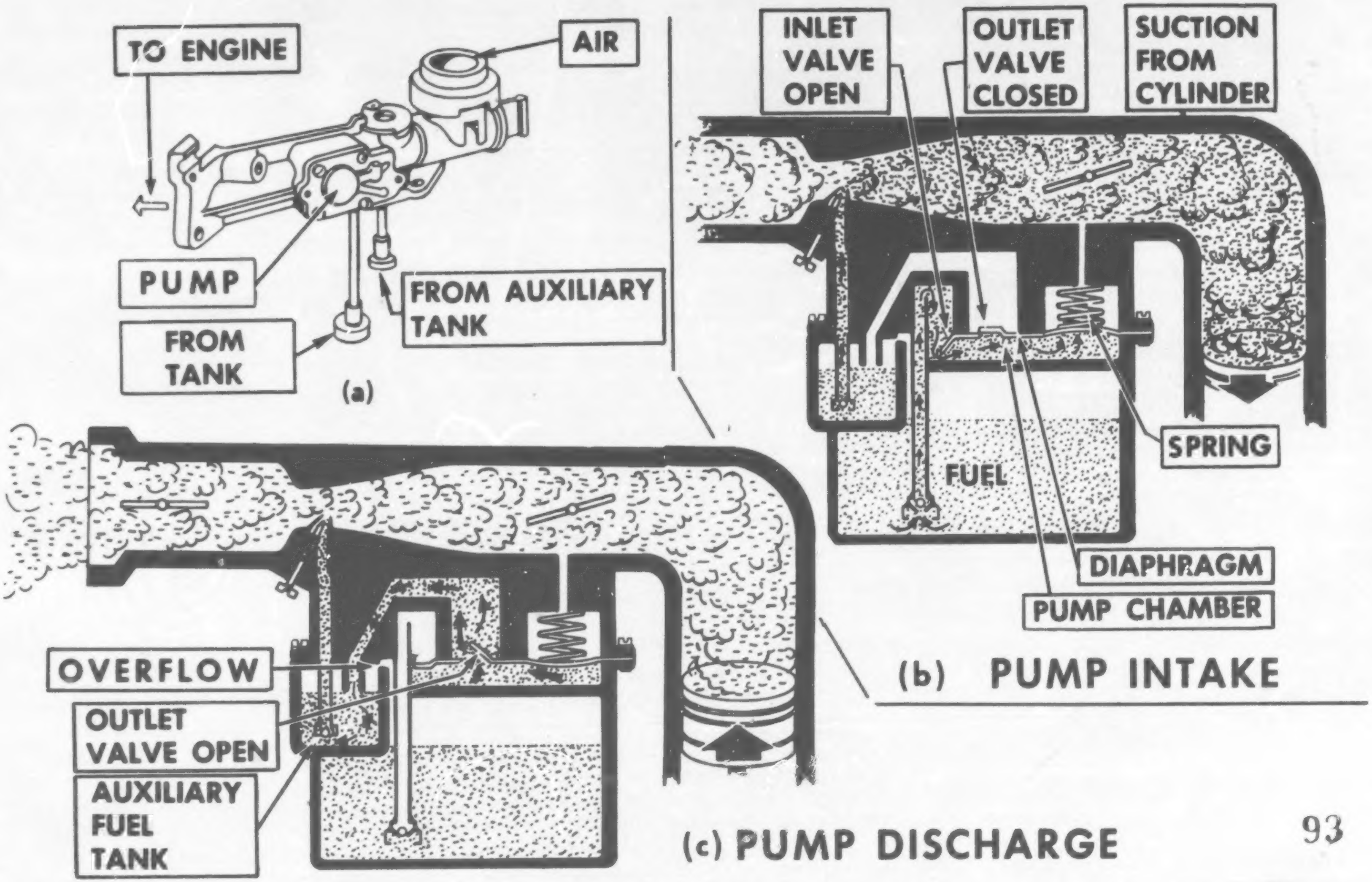
ENGINE RUNNING

ENGINE STOPPED

(c)

(d)

SUCTION-LIFT TYPE CARBURETOR WITH FUEL PUMP

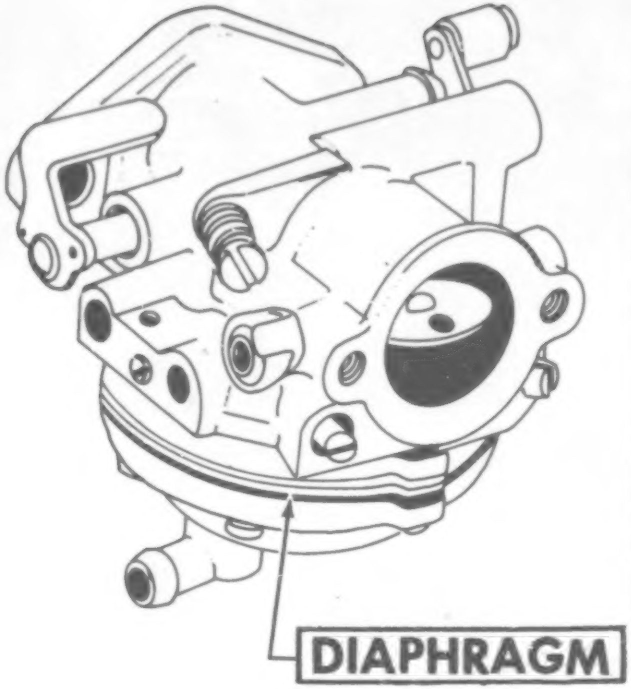

TO ENGINE
AIR
PUMP
FROM AUXILIARY TANK
FROM TANK
INLET VALVE OPEN
OUTLET VALVE CLOSED
SUCTION FROM CYLINDER
FUEL
SPRING
DIAPHRAGM
PUMP CHAMBER
OVERFLOW
OUTLET VALVE OPEN
AUXILIARY FUEL TANK

(a)

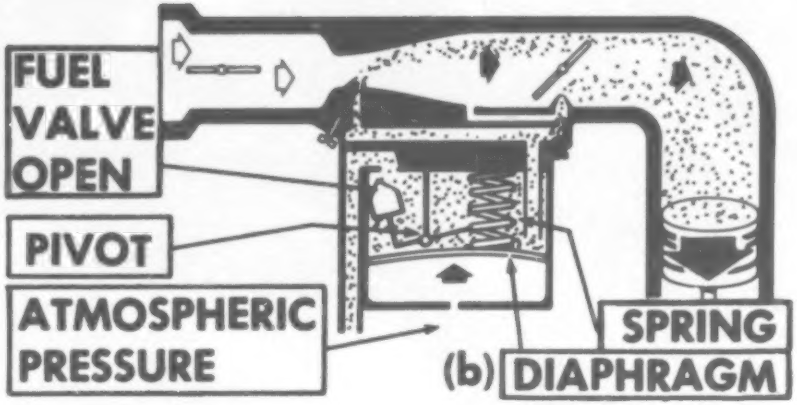
(b) PUMP INTAKE

(c) PUMP DISCHARGE

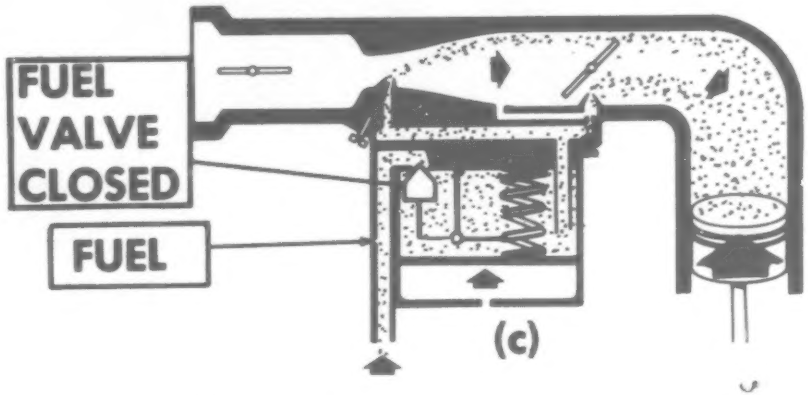
DIAPHRAGM-TYPE CARBURETOR



(a)


FUEL VALVE OPEN
PIVOT
ATMOSPHERIC PRESSURE
SPRING
DIAPHRAGM

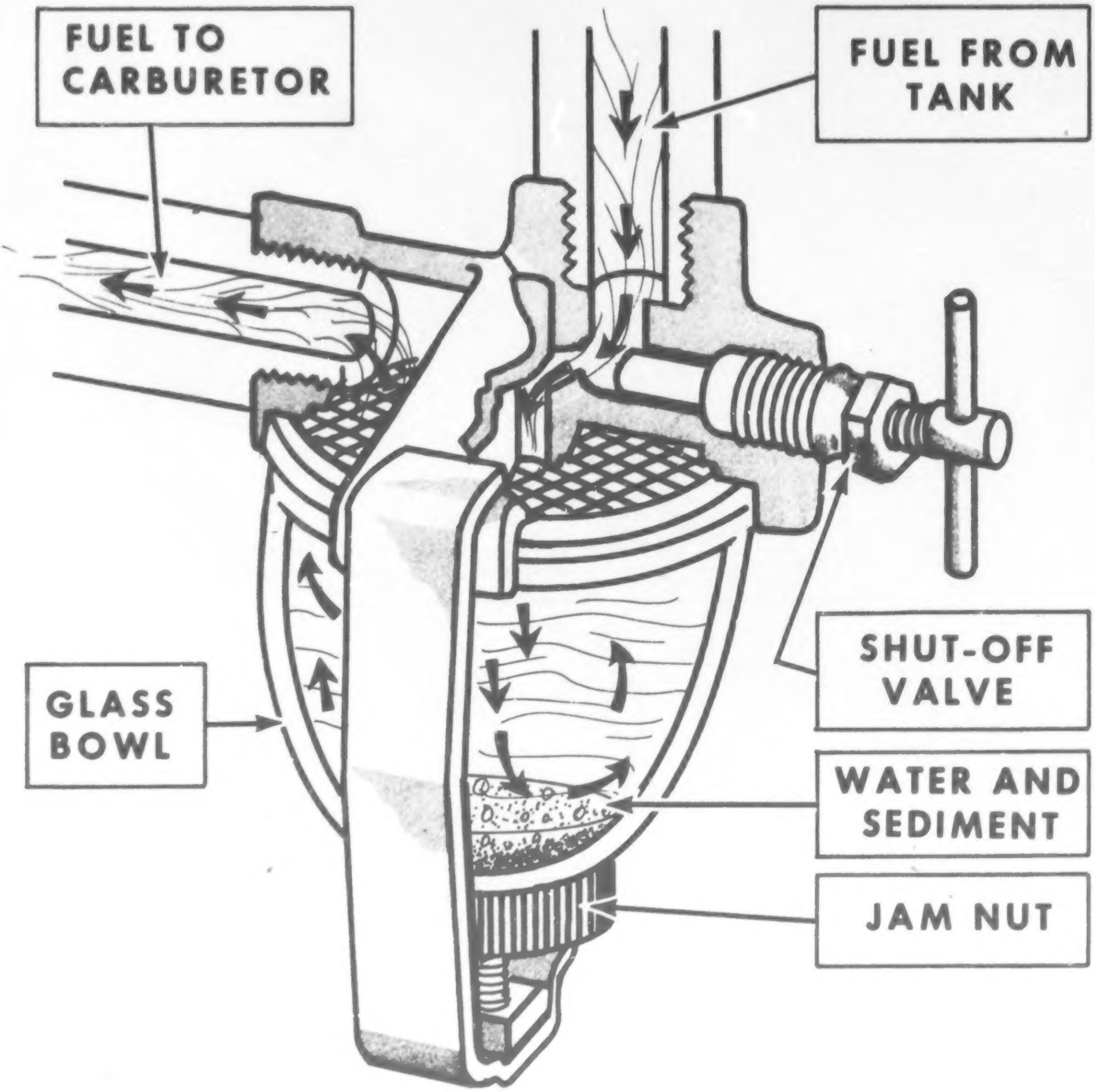
(b)


FUEL VALVE CLOSED
FUEL

(c)

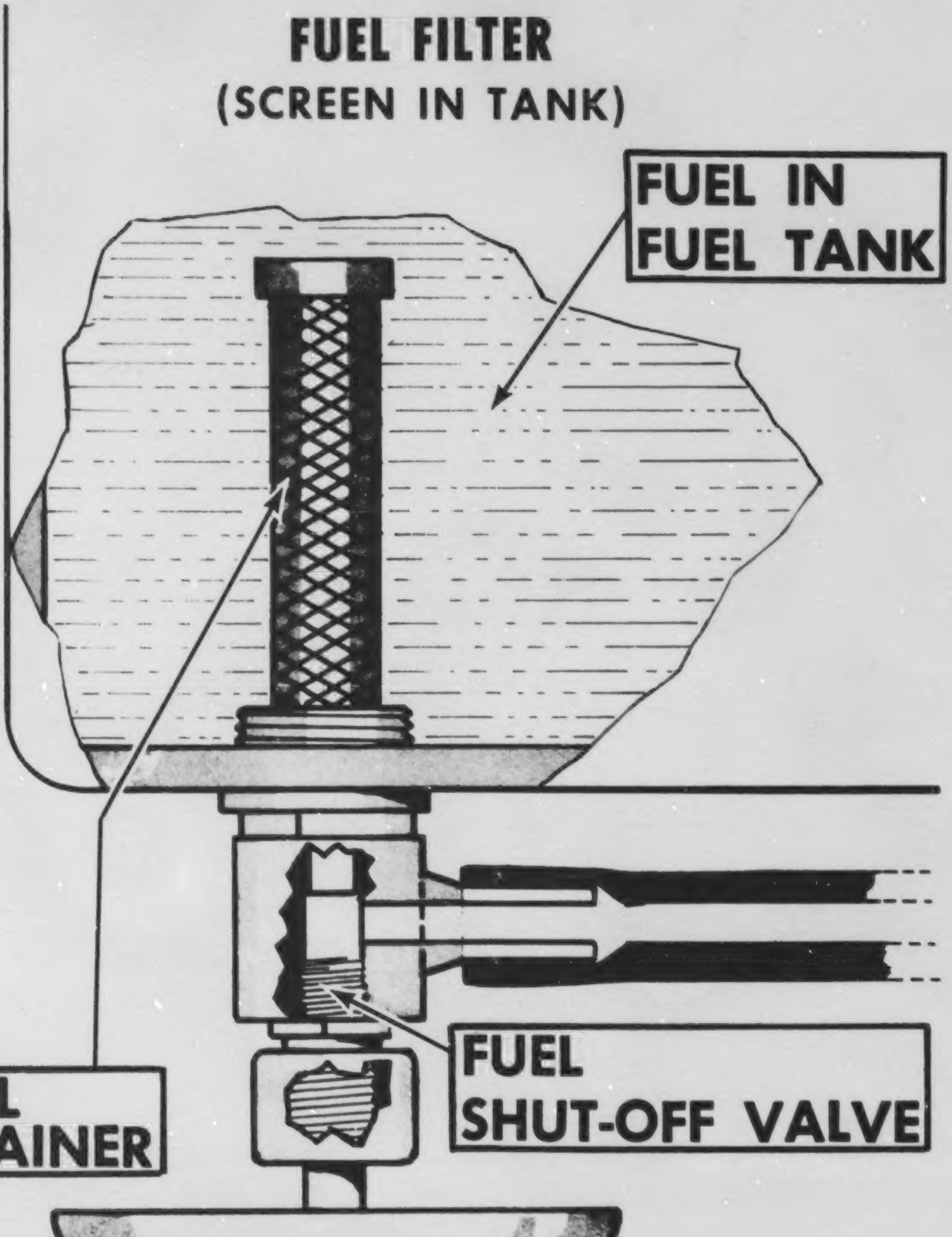
FUEL-FILTER

(GLASS SEDIMENT BOWL AND SCREEN)

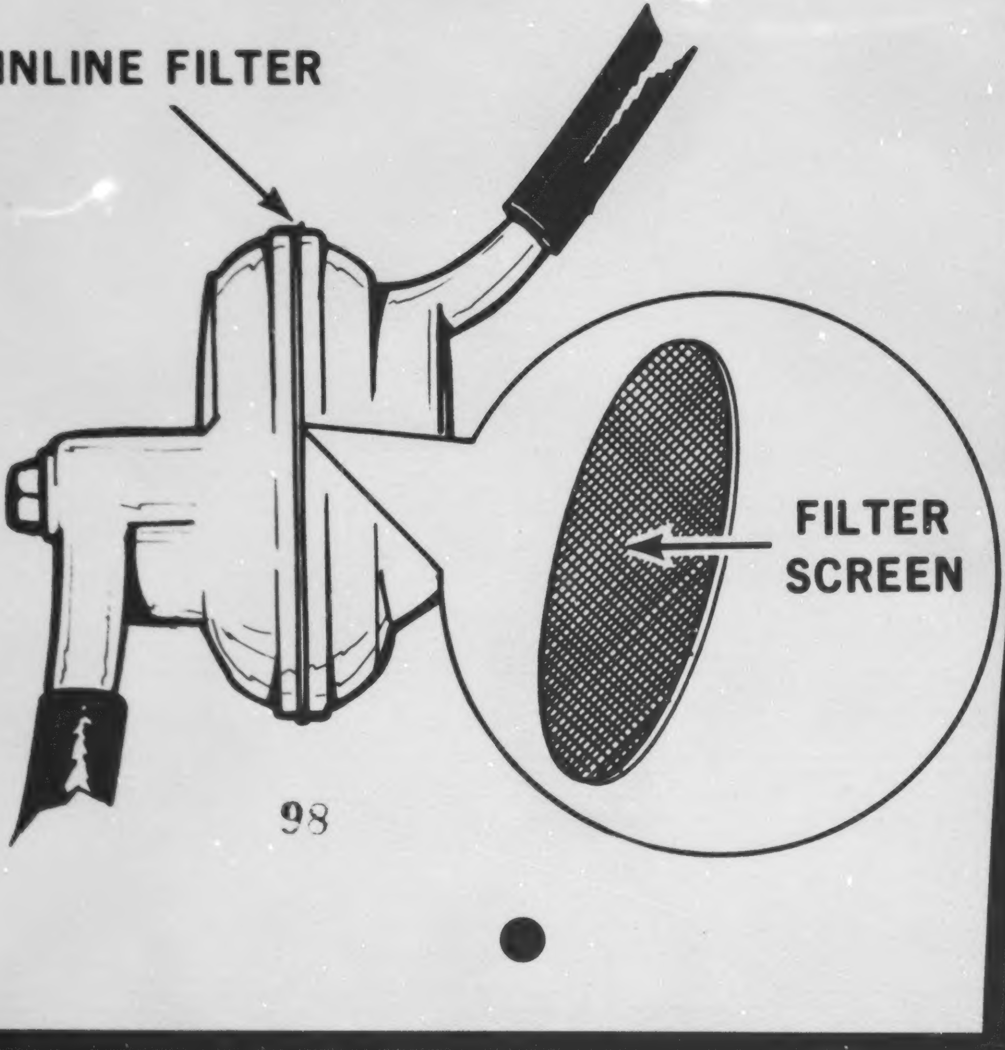

FUEL TO CARBURETOR
FUEL FROM TANK
SHUT-OFF VALVE
GLASS BOWL
WATER AND SEDIMENT
JAM NUT

FUEL FILTER

(SCREEN IN TANK)

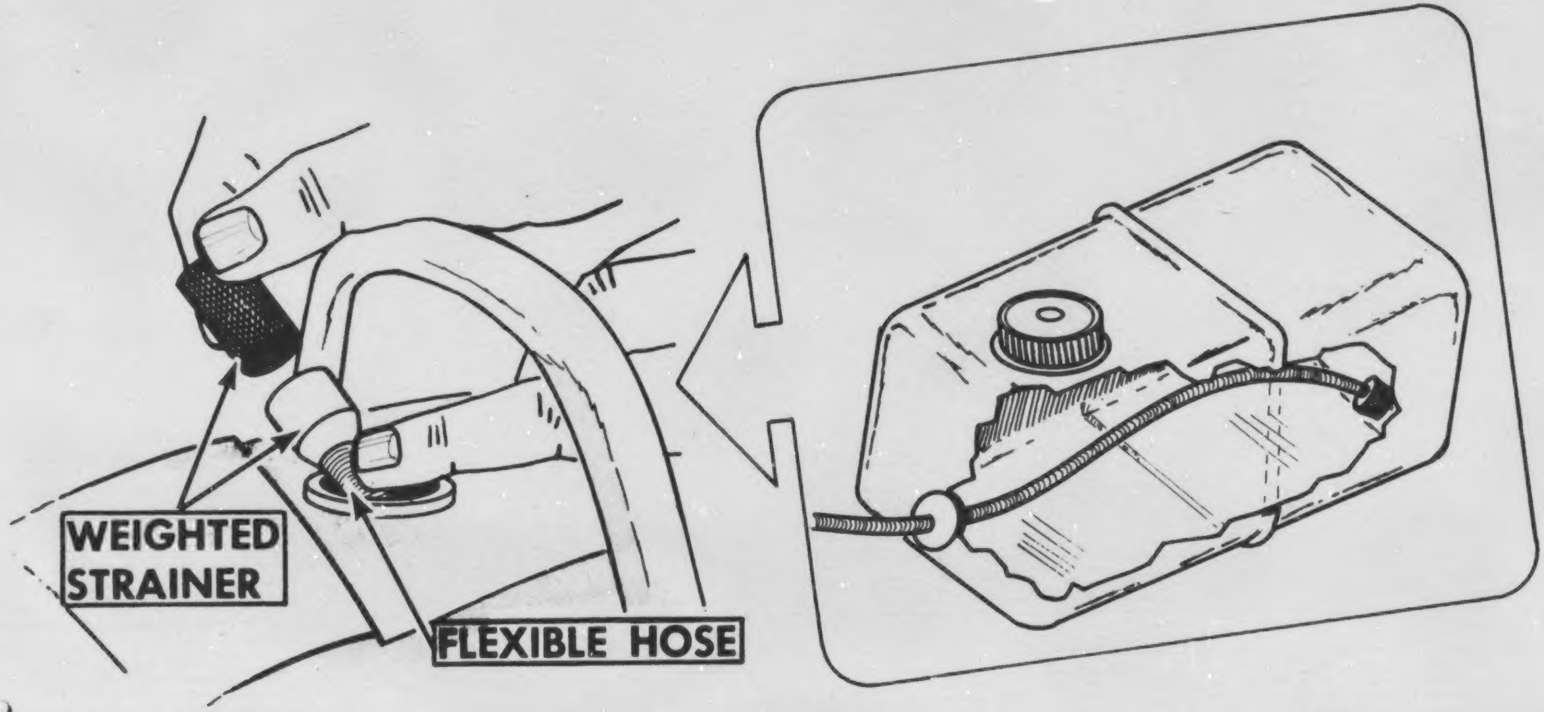

FUEL IN
FUEL TANK
FUEL
STRAINER
FUEL
SHUT-OFF VALVE

INLINE FILTER SCREEN

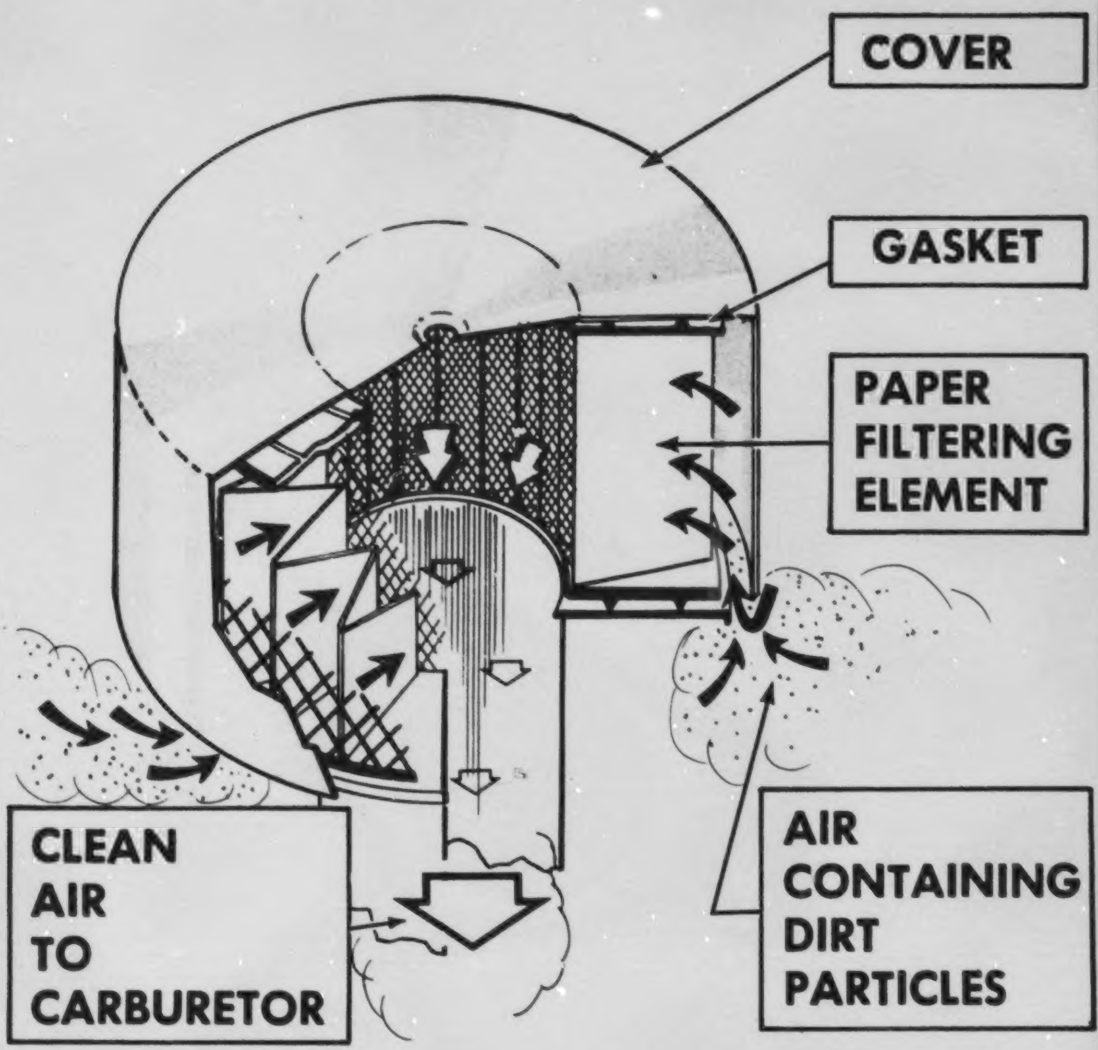

INLINE FILTER
FILTER SCREEN

FUEL FILTER

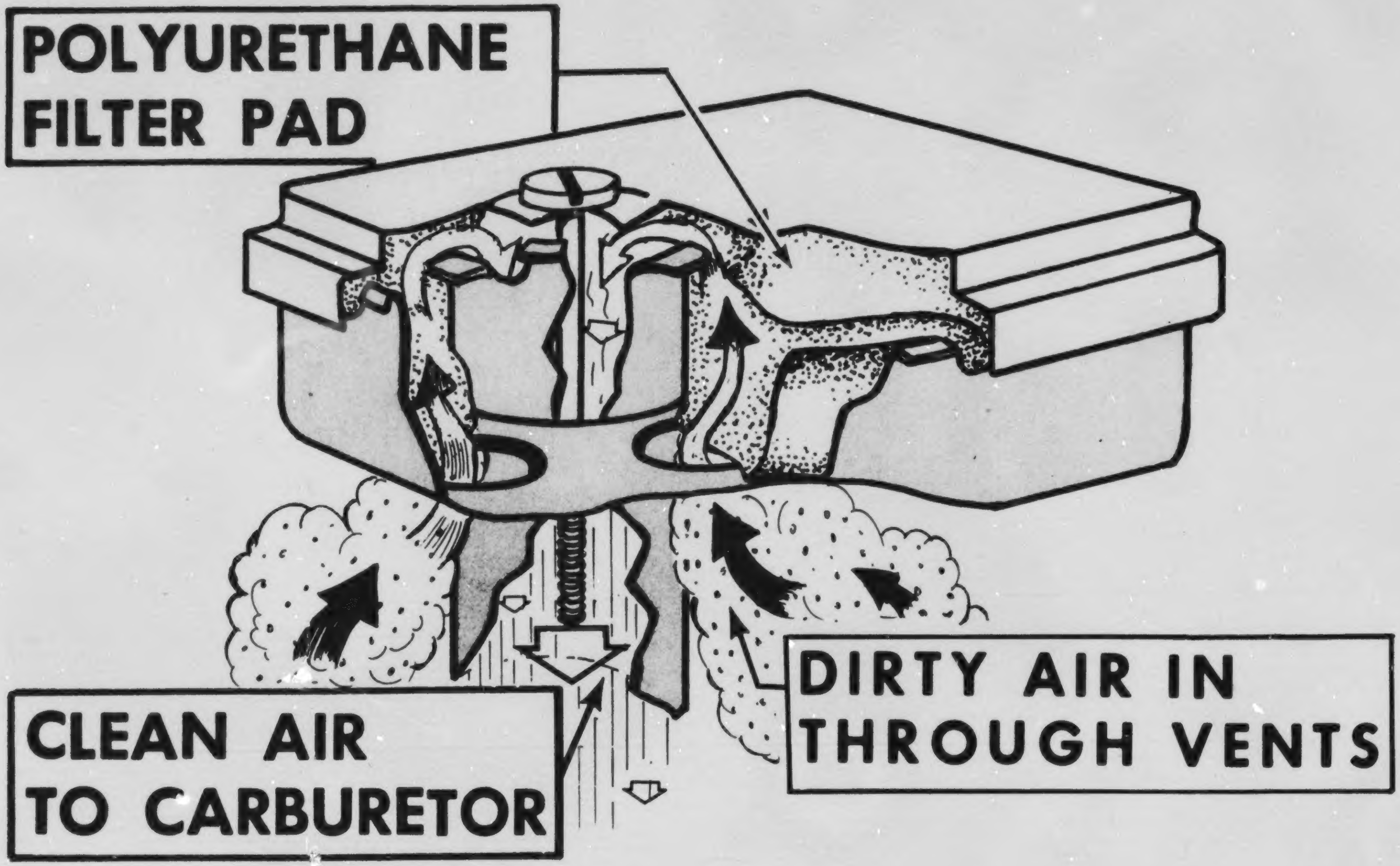
(STRAINER ON FUEL PICK-UP HOSE)


WEIGHTED STRAINER
FLEXIBLE HOSE

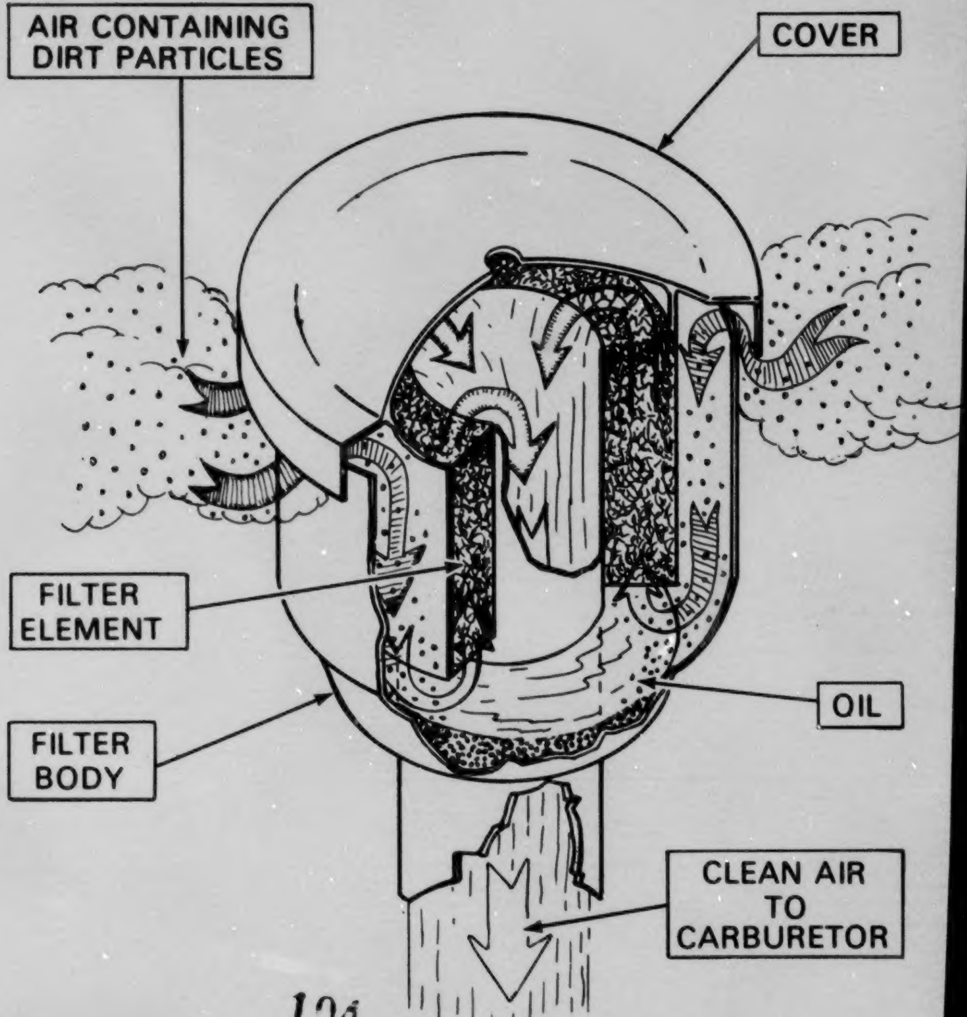
DRY-FILTER AIR CLEANER


COVER
GASKET
PAPER FILTERING ELEMENT
CLEAN AIR TO CARBURETOR
AIR CONTAINING DIRT PARTICLES

OILED-FILTER AIR CLEANER


POLYURETHANE FILTER PAD
CLEAN AIR TO CARBURETOR
DIRTY AIR IN THROUGH VENTS

OIL-BATH AIR CLEANER


AIR CONTAINING DIRT PARTICLES
COVER
FILTER ELEMENT
OIL
FILTER BODY
CLEAN AIR TO CARBURETOR

CRANKCASE OIL RECOMMENDATIONS

(4-CYCLE ENGINES)

MANUFACTURER	ABOVE 40°F.	ABOVE 32°F.	BELOW 5°F.	BELOW 0°F.	BELOW –10°F.
Briggs & Stratton	SAE 30 or 10W-30	5W-20 or 5W-30		SAE 10W diluted with 10% kerosene	
Clinton	SAE 30		10W		5W
Kohler	SAE 30		SAE 10W	5W or 5W-20	
Wisconsin	SAE 30	SAE 20 or SAE 20W	10W		
Tecumseh	SAE 30		5W-20 5W-30	10W diluted with 10% kerosene	
	10W-30	10W-40			

CARBURETION

JOB SHEET #1 - SERVICING AN OIL-BATH AIR CLEANER

Instructions: Following correct procedure, service an oil-bath air cleaner provided by the instructor.

I. Secure the proper tools from the instructor.

II. Procedure for servicing:

- A. Disconnect the spark plug wire.
- B. Loosen oil cup or cover and remove the air cleaner.
- C. Cover the exposed air intake on carburetor.
- D. Check depth of sediment deposit.
- E. Discard dirty oil.
- F. Clean cup, filter and other parts with solvents.
- G. Check air intake pipe to the carburetor for dirt.
- H. Refill cup with oil to the correct oil level.
- I. Remove cover from intake.
- J. Assemble the air cleaner, install and tighten.
- K. Reconnect the spark plug wire.

CARBURETION

JOB SHEET #2 - SERVICING AN OIL-FILTER AIR CLEANER

Instructions: Following correct procedure, service an oil-filter air cleaner provided by the instructor.

I. Secure the proper tools from the instructor.

II. Procedures for servicing:

  A. Disconnect the spark plug wire.

  B. Clean the area around the air cleaner.

  C. Remove the filter element cover.

  D. Remove the filter element.

  E. Check the condition of the filter element and other parts.

  F. Cover the carburetor intake opening.

  G. Clean the filter.

  H. Dry the filter element.

  I. Remove the protective cover from the air intake and clean.

  J. Oil the filter with a few drops of oil.

  K. Replace filter element.

  L. Install the filter unit.

  M. Reconnect the spark plug wire.

CARBURETION

JOB SHEET #3 - SERVICING A DRY-FILTER AIR CLEANER

Instructions: Following correct procedure, service a dry-filter air cleaner provided by the instructor.

I. Secure the proper tools from the instructor.

II. Procedures for servicing:

   A. Disconnect the spark plug.

   B. Clean the area around the air cleaner.

   C. Remove the filter element.

   D. Cover the air intake.

   E. Check the condition of the filter and other parts.

   F. Clean the filter element.

   (NOTE: If filter is paper, clean by tapping it on a flat surface.)

   (CAUTION: Do not wash it unless instructed to do so by the manufacturer.

   G. Remove protective cover from carburetor.

   H. Clean filter cover and carburetor intake.

   I. Replace filter element.

   J. Replace cover.

   K. Reconnect the spark plug.

CARBURETION

JOB SHEET #4 - SERVICING SEDIMENT BOWL AND FUEL FILTER

Instructions: Following correct procedure, service the sediment bowl and fuel filter provided by the instructor.

I. Secure the proper tools from the instructor.

II. Procedures for servicing:

   A. Disconnect the spark plug wire.

   B. Close shut off valve to the fuel.

   C. Loosen jam nut and swing the wire bail to one side on the sediment bowl.

   D. Remove the bowl using a twisting motion.

   E. Remove the gasket and check.

   F. Remove the strainer screen and check.

   G. Wash the screen and filter element.

   H. Clean the sediment bowl and dry.

   I. Open fuel valve, drain and collect in a container about one cup of fuel from tank,removing any sediment in the bottom of tank.

   J. Install gasket, strainer and sediment bowl

   K. Fill the sediment bowl before tightening the jam nut.

   L. Tighten bowl against gasket with jam nut.

   M. Check for leaks before operating the engine.

   N. Replace the spark plug wire.

   O. Operate engine for a few minutes and recheck for leaks.

CARBURETION

TEST

I. Match the following terms to the proper definition.

___A. A device for filtering, cleaning and removing dust from the air entering the engine

___B. A device for automatically mixing fuel in the proper proportion with air to produce a combustible gas.

___C. A reservoir for gas before being used by the motor and to maintain a sufficient supply available.

___D. A device that restricts the volume of air admitted into the carburetor which allows a raw mixture of gas to enter the cylinder for easy starting.

___E. A hollow tank that is lighter than the gas, which forces the float needle valve into the seat and stops the gas flow when the bowl is full.

___F. Stops the gas flow into the carburetor when the bowl is full.

___G. A device to control and regulate the speed of an engine.

___H. Refers to the oxidized petroleum products which accumulate in the fuel system.

___I. Refers to the engine operating at its slowest speed.

___J. Regulates the gas flow into the nozzle.

___K. Regulates the gas flow to get different speeds.

___L. Causes gas to spray from the nozzle.

1. Air Cleaner
2. Carburetor
3. Carburetor Bowl
4. Choke
5. Float
6. Float Needle Valve
7. Governor
8. Gum
9. Idle
10. Needle Valve
11. Throttle
12. Venturi

II. Name three types of carburetors for small gas engines.

A.

B.

C.

III. Name four types of fuel filters found on small gas engines.

A.

B.

C.

D.

IV. List three different types of air cleaners.

A.

B.

C.

V. Trace the fuel from the gas tank to cylinder.

A. Gas tank-- B. ______ C. ______________________

D. ______________________ E. ______________________

F. ______________________ G. ______________________

H. ______________________ I. ______________________

J. ______________________ K. ______________________

VI. List three types of engine cleaning solutions

A.

B.

C.

VII. List four steps in adjusting the carburetor on a small gas engine.

A.

B.

C.

D.

VIII. List the purpose of lubricants.

A.

IX. Demonstrate the ability to trouble shoot a carburetion problem on a small gas engine provided by the instructor.

X. Demonstrate the ability to service an oil-bath air cleaner.

XI. Demonstrate the ability to service an oil-filter air cleaner.

XII. Demonstrate the ability to service a dry-filter air cleaner.

XIII. Demonstrate the ability to service a sediment bowl and fuel filter.

CARBURETION

ANSWERS TO TEST

I. A. 1

B. 2

C. 3

D. 4

E. 5

F. 6

G. 7

H. 8

I. 9

J. 10

K. 11

L. 12

II. A. Gravity type

B. Suction type

C. Diaphram type

III. A. Combination sediment bowl

B. Screen in the fuel tank

C. Inline filter screen

D. Strainer on fuel pick-up hose

IV. A. Oil-bath

B. Oil-filter

C. Dry-filter

V. A. Gas tank--- B. Gas line--- C. Float needle valve --- D. Float needle seat--- E. Carburetor Bowl--- F. Nozzle--- G. Venturi--- H. Throat--- I. Intake manifold--- J. Intake valve--- K. Cylinder.

VI. A. Steam
  B. Petroleum solvents
  C. Commercial degreasers

VII. A. Run engine at operating speed.
  B. Turn the needle valve in until the engine slows down.
  C. Then turn the needle valve out until the engine speeds up and slows down.
  D. Turn the valve back again to a point half-way between these two points.

VIII. A. To reduce internal friction in order to:
  1. Obtain more useable horsepower.
  2. To reduce operating temperature.

IX. Performance skills to be evaluated by the instructor.

X. Performance skills to be evaluated by the instructor.

XI. Performance skills to be evaluated by the instructor.

XII. Performance skills to be evaluated by the instructor.

XIII. Performance skills to be evaluated by the instructor.

UNIT IV

JOB OPPORTUNITIES

FARM MACHINERY JOB OPPORTUNITIES

TERMINAL OBJECTIVE

The student, upon completion of Unit IV should be able to describe several job opportunities related to the farm machinery field and score at least eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

I. List nine sources used in finding jobs.

II. List six steps to take in obtaining a job.

III. List fourteen factors to consider before choosing an occupation.

IV. List four steps of job advancement.

V. Name three factors which determine the speed of job advancement.

VI. Name six expectations of an employer.

VII. Name four expectations of an employee.

VIII. List five major career areas of the farm machinery field.

IX. List nine on-the-farm jobs in the farm machinery field.

X. List five jobs in the manufacturers, research, development and sales areas of the farm machinery field.

XI. Name six jobs in the distribution or dealers sales area of the farm machinery field.

XII. Name eight jobs in the distribution or dealers service area in the farm machinery field.

XIII. List five jobs in the distribution or dealers parts area of the farm machinery field.

FARM MACHINERY JOB OPPORTUNITIES

SUGGESTED ACTIVITIES

I. Instructor:

  A. Provide students with terminal and specific objectives.

  B. Provide students with information and assignment sheets.

  C. Make transparencies.

  D. Discuss the terminal and specific objectives.

  E. Discuss the information and assignment sheets.

  F. Give test.

II. Students:

  A. Read objectives.

  B. Study information sheets.

  C. Complete assignment sheets.

  D. Take test.

INSTRUCTIONAL MATERIALS

I. Materials included in this unit:

  A. Objectives

  B. Information sheet

  C. Transparency masters

    1. TM 1 - Factors Determine Job Advancement

  D. Assignment sheet

    1. Assignment sheet #1 - Farm Machinery Occupational Survey

  E. Answers to assignment sheets

  F. Test

  G. Answers to test

II. References:

A. Agricultural Equipment Technology, Washington, U.S. Government Printing Office, 1970.

B. Agricultural Sales and Service, Mid-America Vocational Curriculum Consortium, Inc., 1976.

C. The Encyclopedia of Careers and Vocational Guidance, J.G. Ferguson Publishing CO., 1975, Volume I & II.

D. Occupational Outlook Handbook, U.S. Department of Labor, 1978-79.

E. Dictionary of Occupational Titles, Volume I & II, 1965.

FARM MACHINERY JOB OPPORTUNITIES

INFORMATION SHEET

I. Nine sources used in finding jobs.

   A. Dictionary of occupational titles (Department of Labor)

   B. Former employees

   C. School placement bureau

   D. Help wanted advertisements

   E. Letter of inquiry

   F. Personnel offices

   G. Friends and relatives

   H. State Employment Service

   I. Former employers

II. Six steps to take in obtaining a job.

   A. Choose field

   B. Locate job prospects

   C. Prepare a personal resume

   D. Fill out an application

   E. Arrange for an interview

   F. Interview

III. Fourteen factors to be considered before choosing an occupation.

   A. Education and training requirements

   B. Nature of work

   C. Mental or physical efforts required

   D. Working conditions

   E. Personal qualifications

   F. Amount of travel required

INFORMATION SHEET

- G. Job variety
- H. Personal risk involved
- I. Regular or seasonal employment
- J. Regular hours
- K. Personal expense
- L. Advancement opportunities
- M. Fringe benefits
- N. Financial earnings

IV. Four steps of job advancement.

- A. Laborer
- B. Supervisor
- C. Assistant Manager
- D. Manager or Owner

V. Three factors which determine the speed of job advancement.

- A. Education
- B. Experience
- C. Seniority

VI. Six expectations of an employer.

- A. Loyalty
- B. Proper use of ability
- C. Cooperation
- D. Good working relationships
- E. Good working habits
- F. Honesty

INFORMATION SHEET

VII. Four expectations of an employee.

- A. Money
- B. Recognition
- C. Security
- D. Pleasant working conditions

VIII. Five major career areas of the farm machinery field.

- A. On-the-farm careers
- B. Manufacturers, research, development and sales careers.
- C. Distribution or dealers sales careers.
- D. Distribution or dealers service careers.
- E. Distribution or dealers parts careers.

IX. Nine on-the-farm jobs in the farm machinery field.

- A. Owner and operator of the farm and equipment.
- B. Contractor of services requiring equipment.
- C. Supervisor of a mechanical operation.
- D. Supervisor of a contracting operation.
- E. Supervisor of machinery servicing, operation and maintenance.
- F. Farm mechanical specialist.
- G. Farm manager or supervisor.
- H. Contract (custom) operator.
- I. Farm laborer

X. Five jobs in the manufacturers, research, development and sales areas of the farm machinery field.

- A. Field testing technician
- B. Equipment salesperson
- C. Equipment parts and service specialist

INFORMATION SHEET

   - D. Equipment demonstrator and trouble shooter
   - E. Field technician

XI. Six jobs in the distribution or dealers sales area of the farm machinery field.

   - A. Sales manager - dealership, branch or local
   - B. District manager - dealership, branch or local
   - C. Farm equipment salesperson - dealership, branch or local
   - D. Industrial salesperson - dealership
   - E. Farm mechanization salesperson
   - F. Lawn and garden equipment salesperson

XII. Eight jobs in the distribution or dealers service area in the farm machinery field.

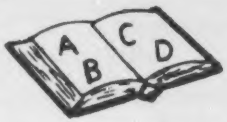
   - A. Service supervisor
   - B. Company or distributor service supervisor
   - C. Serviceperson and equipment specialist
   - D. Diesel serviceperson
   - E. Hydraulics serviceperson
   - F. Air conditioning serviceperson or specialist
   - G. Farm mechanization serviceperson or specialist
   - H. Set-up and delivery serviceperson

XIII. Five jobs in the distribution or dealers parts area of the farm machinery field.

   - A. Parts supervisor
   - B. Parts salesperson
   - C. Parts person
   - D. Warehouse supervisor
   - E. Warehouse person

FACTORS DETERMINE JOB ADVANCEMENT

EDUCATION



EXPERIENCE

3 25 10 9 7

SENIORITY

5 4 6 1

2 15 8 20

FARM MACHINERY JOB OPPORTUNITIES

ASSIGNMENT SHEET #1 - FARM MACHINERY OCCUPATIONAL SURVEY

Different Types of Jobs in Your Area	Working Conditions	Wages	Benefits	Qualifications
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

FARM MACHINERY JOB OPPORTUNITIES

ANSWERS TO ASSIGNMENT SHEETS

Assignment sheet #1

To the satisfaction of the instructor.

FARM MACHINERY JOB OPPORTUNITIES

TEST

I. List nine sources used in finding jobs.

A.

B.

C.

D.

E.

F.

G.

H.

I.

II. List six steps to take in obtaining a job.

A.

B.

C.

D.

E.

F.

III. List fourteen factors to consider before choosing an occupation.

A.

B.

C.

D.

E.

F.

G.

H.

I.

J.

K.

L.

M.

N.

IV. List four steps of job advancement.

A.

B.

C.

D.

V. Name three factors which determine the speed of job advancement.

A.

B.

C.

VI. Name six expectations of an employer.

A.

B.

C.

D.

E.

F.

VII. Name four expectation of an employee.

A.

B.

C.

D.

VIII. List five major career areas of the farm machinery field.

A.

B.

C.

D.

E.

IX. List nine on-the-farm jobs in the farm machinery field.

A.

B.

C.

D.

E.

F.

G.

H.

I.

X. List five jobs in the manufacturers, research, development and sales areas of the farm machinery field.

A.

B.

C.

D.

E.

XI. Name six jobs in the distribution or dealers sales area of the farm machinery field.

A.

B.

C.

D.

E.

F.

XII. Name eight jobs in the distribution or dealers service area in the farm machinery field.

A.

B.

C.

D.

E.

F.

G.

H.

XIII. List five jobs in the distribution or dealers parts area of the farm machinery field.

A.

B.

C.

D.

E.

FARM MACHINERY JOB OPPORTUNITIES

ANSWERS TO TEST

I. A. Dictionary of occupational titles (Department of Labor)

B. Former employees

C. School Placement Bureau

D. Help wanted advertisements

E. Letter of inquiry

F. Personnel offices

G. Friends and relatives

H. State Employment Service

I. Former employers

II. A. Choose field

B. Locate job prospects

C. Prepare a personal resume

D. Fill out an application

E. Arrange for an interview

F. Interview

III. A. Education and training requirements

B. Nature of work

C. Mental or physical efforts required

D. Working conditions

E. Personal qualifications

F. Amount of travel required

G. Job variety

H. Personal risk involved

I. Regular or seasonal employment

J. Regular hours
K. Personal expense
L. Advancement opportunities
M. Fringe benefits
N. Financial earnings

IV. A. Laborer
B. Supervisor
C. Assistant Manager
D. Manager or Owner

V. A. Education
B. Experience
C. Seniority

VI. A. Loyalty
B. Proper use of ability
C. Cooperation
D. Good working relationships
E. Good working habits
F. Honesty

VII. A. Money
B. Recognition
C. Security
D. Pleasant working conditions

VIII. A. On-the-farm careers
B. Manufacturers, research, development and sales careers
C. Distribution or dealers sales careers
D. Distribution or dealers service careers
E. Distribution or dealers parts careers

IX. A. Owner and operator of the farm and equipment.
    B. Contractor of services requiring equipment.
    C. Supervisor of a mechanical operation.
    D. Supervisor of a contracting operation.
    E. Supervisor of machinery servicing, operation and maintenance.
    F. Farm mechanical specialist.
    G. Farm manager or supervisor.
    H. Contract (custom) operator.
    I. Farm laborer.

X. A. Field testing technician.
    B. Equipment salesperson.
    C. Equipment parts and service specialist.
    D. Equipment demonstrator and trouble shooter.
    E. Field technician.

XI. A. Sales manager - dealership, branch or local
    B. District manager - dealership, branch or local
    C. Farm equipment salesperson - dealership, branch or local
    D. Industrial salesperson - Dealership
    E. Farm mechanization salesperson
    F. Lawn and garden equipment salesperson

XII. A. Service supervisor
    B. Company or distributor service supervisor
    C. Serviceperson and equipment specialist
    D. Diesel serviceperson
    E. Hydraulics serviceperson
    F. Air conditioning serviceperson or specialist
    G. Farm mechanization serviceperson or specialist

H. Set-up and delivery serviceperson

XIII. A. Parts supervisor

B. Parts salesperson

C. Parts person

D. Warehouse supervisor

E. Warehouse person

UNIT V

TRACTOR SAFETY

TRACTOR SAFETY

TERMINAL OBJECTIVE

The student, upon completion of Unit V, should understand the importance of tractor safety and develop an awareness of hazards encountered while operating a farm tractor in order to prevent tractor accidents.

SPECIFIC OBJECTIVES

After completion of this unit of instruction, the student should be able to:

I. Match five terms associated with tractor safety.

II. List the three steps to follow in prevention of accidents.

III. Name five characteristics of a safe tractor operator.

IV. List nineteen factors divided into four groups that can affect the operator capacity.

V. List four safety steps taken before dismounting a tractor.

VI. Name six daily maintenance checks made before operating a tractor which could insure the operators safety.

VII. Draw and identify the two colors of the slow moving vehicle emblem. (SMV)

VIII. List three reasons why the SMV emblem is needed.

IX. Name seven types of tractor accidents.

X. Identify the two ways a tractor will upset.

XI. List twelve common surface hazards associated with tractor upsets.

XII. Name six safety precautions to avoid backward overturns of tractors.

XIII. Name four safety precautions to avoid side overturns of tractors.

XIV. Figure the center of gravity on a farm tractor.

XV. List five causes of falls from tractors.

XVI. Name seven safety precautions to prevent falls from tractors.

XVII. List three problems encountered when slow and fast vehicles are using the same road.

XVIII. Name nine highway safety rules.

XIX. List four types of power take off shields. (PTO)

XX. Name eight safety precautions that could prevent PTO accidents.

XXI. List six types of clothing that should not be worn while working around PTO shafts.

XXII. List five steps involved in properly hitching a PTO drive line.

XXIII. Name three elements that must be present in order to induce fire.

XXIV. List five ways to reduce the possibility of fire on or around a tractor.

TRACTOR SAFETY

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with terminal and specific objectives, information sheets and assignment sheets.

   B. Discuss the terms concerning tractor safety.

   C. Explain the importance of tractor safety on and off the roads.

   D. Discuss the types of tractor accidents that have occured in the surrounding area.

   E. Make transparencies.

   F. Discuss the assignment sheets and demonstrate the procedure on the assignment sheets.

   G. Give test.

II. Students:

   A. Study the information sheets provided by the instructor.

   B. Complete the assignment sheets and return to the instructor.

   C. Demonstrate the ability to perform the jobs listed on the assignment sheets.

   D. Take test.

INSTRUCTIONAL MATERIALS

I. Materials included in this unit:

   A. Objectives

   B. Information sheets

   C. Transparency masters

      1. TM 1 - Safety Starts At Home (1)

      2. TM 2 - Slow Moving Vehicle Emblem (1)

3. TM 3a - Transport Safety (1)

   TM 3b - Tractor Safety and Transport (1)

   TM 3c - Be Courteous At All Times (1)

D. Assignment sheets

1. Assignment sheet #1 - Tractor Accident Survey

E. Answers to assignment sheets

F. Test

G. Answers to test

II. References:

A. John Deere Operator Manuals, John Deere and Co.

B. Case Operator Manuals, J.I. Case Co.

C. I.H. Farm Equipment Safety Teaching Kit, International Harvester Co.

D. Fundamentals of Machine Operation Tractors, Moline, Illinois, Deere and Co., 1974.

TRACTOR SAFETY

INFORMATION SHEET

I. Terms and definitions:

   A. SAFETY - The condition of being safe from hurt, injury or loss.

   B. ACCIDENT - Any unplanned, unforseen or unexpected occurance of such a nature that personal injury, impairment of health or property damage may result there from, either directly or indirectly.

   C. PREVENTABLE ACCIDENT - One in which you failed to do everything you reasonably could have done to prevent it.

   D. NON-PREVENTABLE ACCIDENT - One which every possible thing was done to prevent the accident but still happened.

   E. HAZARD - A source of danger.

II. Three steps to follow in prevention of accidents:

   A. See the hazard

   B. Know the defense

   C. Act in time

III. Five characteristics of a safe tractor operator:

   A. Knoweldge

   B. Alertness

   C. Foresight

   D. Judgement

   E. Skill

IV. Nineteen factors divided into four groups that can affect the operators capacity:

   A. Environmental

      1. Temperature

      2. Dust

INFORMATION SHEET

    3. Noise
    4. Wind
    5. Chemicals
    6. Fumes

B. Personal

    1. State of mind
    2. Attitude
    3. Concerns about other things
    4. Goals, values, etc.

C. Job considerations

    1. Physical
    2. Boredom
    3. Fatigue
    4. Hurrying
    5. Co-workers

D. Home

    1. Rest
    2. Food
    3. Environment
    4. Daily breaks

V. Four steps taken before dismounting a tractor.

A. Check PTO

B. Set brakes

C. Shut off engine

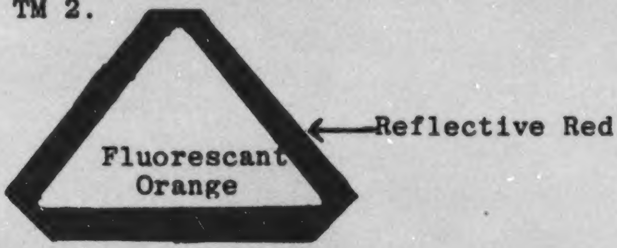
D. Leave shift in neutral or park position

INFORMATION SHEET

VI. Six daily maintenance checks made before operating a tractor which could insure the operators safety. TM 1.

- A. Fuel
- B. Oil
- C. Water
- D. Hydraulic fluid
- E. Tire inflation
- F. Hydraulic hoses

VII. Draw the slow moving vehicle emblem and identify the two colors. TM 2.



VIII. Three reasons why the slow moving vehicle emblem is needed.

- A. For various farm vehicles to utilize public streets and highways.
- B. For drivers of fast moving vehicles to recognize slow moving vehicles to avoid collosions.
- C. To standardize the vehicle as a slow moving type vehicle (less than 25 mph.)

IX. Seven types of tractor accidents.

- A. Tractor upsets
- B. Falls from tractors
- C. Crushed by tractors
- D. Run over by tractors
- E. Motor-vehicle collision
- F. PTO accidents
- G. Fire

INFORMATION SHEET

X. Two ways a tractor will upset.

  A. Backward

  B. Sideways

XI. Twelve common surface hazards associated with tractor upsets.

  A. Speed

  B. Crossing slopes

  C. Uphill

  D. Downhill

  E. Ditches

  F. High hitches

  G. Public roads

  H. Loads on front

  I. Loads on drawbar

  J. Hidden obstacles

  K. Mud

  L. Misuse

XII. Six safety precautions to avoid backward overturns of tractors.

  A. Keep the hitch low.

  B. Back up steep inclines or slopes.

  C. Engage clutch slowly.

  D. Avoid any condition that could cause the front of the tractor to lift off the ground.

  E. Keep a sufficient amount of weights on the front of the tractor.

  F. Don't chain blocks to rear wheel when stuck.

INFORMATION SHEET

XIII. Four safety precautions to avoid side overturns of tractors.

A. Don't drive too fast.

B. Avoid turning sharp

C. Keep front loads low when moving.

D. Don't drive close to ditches.

XIV. Formula for figuring the center of gravity on a farm tractor.

A. Formula:

B = Distance of center of gravity ahead of rear point of support.

B_1 = Wheel base

W_1 = Weight on rear wheel

W_2 = Weight on front wheel

Example problem: A tractor weighing 12,000 lbs. with 100" wheel base from point of front support to point of rear support.

Note: The rear of the tractor comprises 2/3 of the total tractor weight.

$$B = \frac{W2}{W_1 + W_2} \; B_1$$

$$B = \frac{4000}{8000 + 4000} \; 100$$

$$B = 33.3$$

XV. Five causes of falls from tractors.

A. Slippery surfaces

B. Cluttered platform

C. Failure to use hand holds and steps

D. Rough ground

E. Overhead obstructions

INFORMATION SHEET

XVI. Seven safety precautions to prevent falls from tractors.

A. No rider on tractor.

B. Use hand and foot aids for mounting and dismounting.

C. Step off tractor only when stopped.

D. Keep platform clean.

E. Avoid riding on fenders and drawbars.

F. Slow down when crossing rough ground.

G. Keep alert for overhead obstructions.

XVII. Three problems encountered when slow and fast vehicles are using the same road.

A. Stopping distance as the faster vehicle approaches the slower vehicle.

B. Identification of the vehicle as moving slow.

C. Size of the slow moving vehicle presents difficulty in seeing dangers ahead.

XVIII. Nine highway safety rules. TM 3.

A. Use right lane or shoulder.

B. Be courteous, pull off the road and allow cars to pass.

C. Use turn signals and warning flashers.

D. Use required vehicle lighting.

E. Use SMV (Slow moving vehicle) clean and visible.

F. Obey all traffic signals.

G. Slow down for sharp curves.

H. Reduce engine speed going downhill.

I. Beware of blind intersections

INFORMATION SHEET

XIX. Four types of PTO shields.

A. Master shield

B. Tunnel shield

C. Journaled shield

D. Fully shielded

XX. Eight safety precautions of preventing PTO accidents.

A. Use PTO shields.

B. Wear tight fitting clothes and keep hands and feet from PTO.

C. Disengage PTO when dismounting or not in use.

D. Keep work area clean.

E. Never allow riders to ride on the drawbar of a tractor.

F. Never hook 540 RPM equipment to 1000 RPM,PTO or visa versa.

G. Do not service or perform work on a machine without first disengaging the PTO and shutting off the tractor engine.

H. Always be sure PTO is properly attached.

XXI. Six types of clothes that should not be worn while working around PTO shafts.

A. Ties or scarves

B. Loose sleeves

C. Loose pants

D. Cuffs

E. Gloves

F. Loose jackets

XXII. Five steps involved in hitching a PTO drive line.

A. Disengage all power.

INFORMATION SHEET

B. Shut off engine.

C. Wait until PTO shaft stops turning.

D. Keep all shields in place.

E. Keep drawbar in proper position in relation to the PTO shaft.

XXIII. Three elements that must be present in order to induce fire.

A. Air

B. Heat

C. Fuel

XXIV. Five ways to reduce the possibility of fire on or around a tractor.

A. Shut off and allow tractor to cool before refueling.

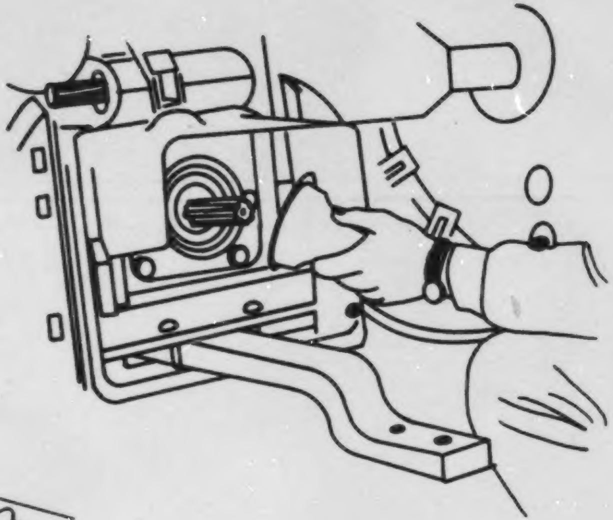
B. Check fuel system for leaks and damage.

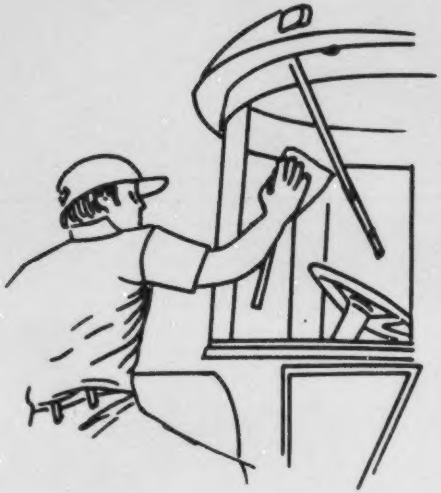
C. Do not smoke while refueling.

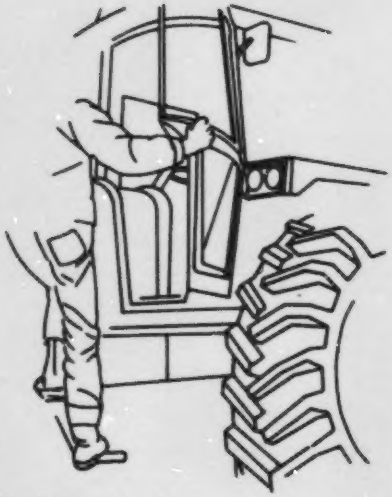
D. Keep tractor and equipment free from chaff and grease.

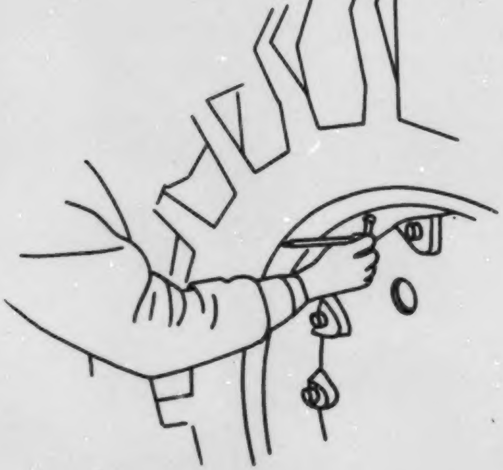
E. Keep a fire extinguisher on tractor.

SAFETY STARTS AT HOME

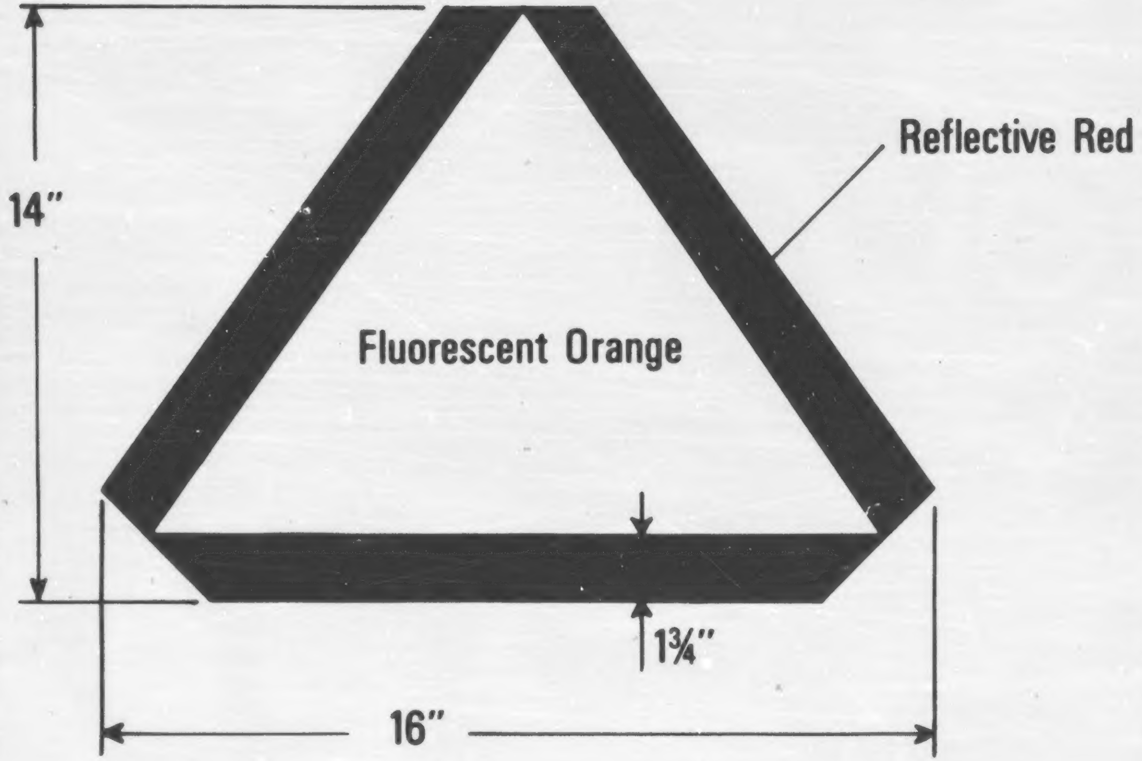




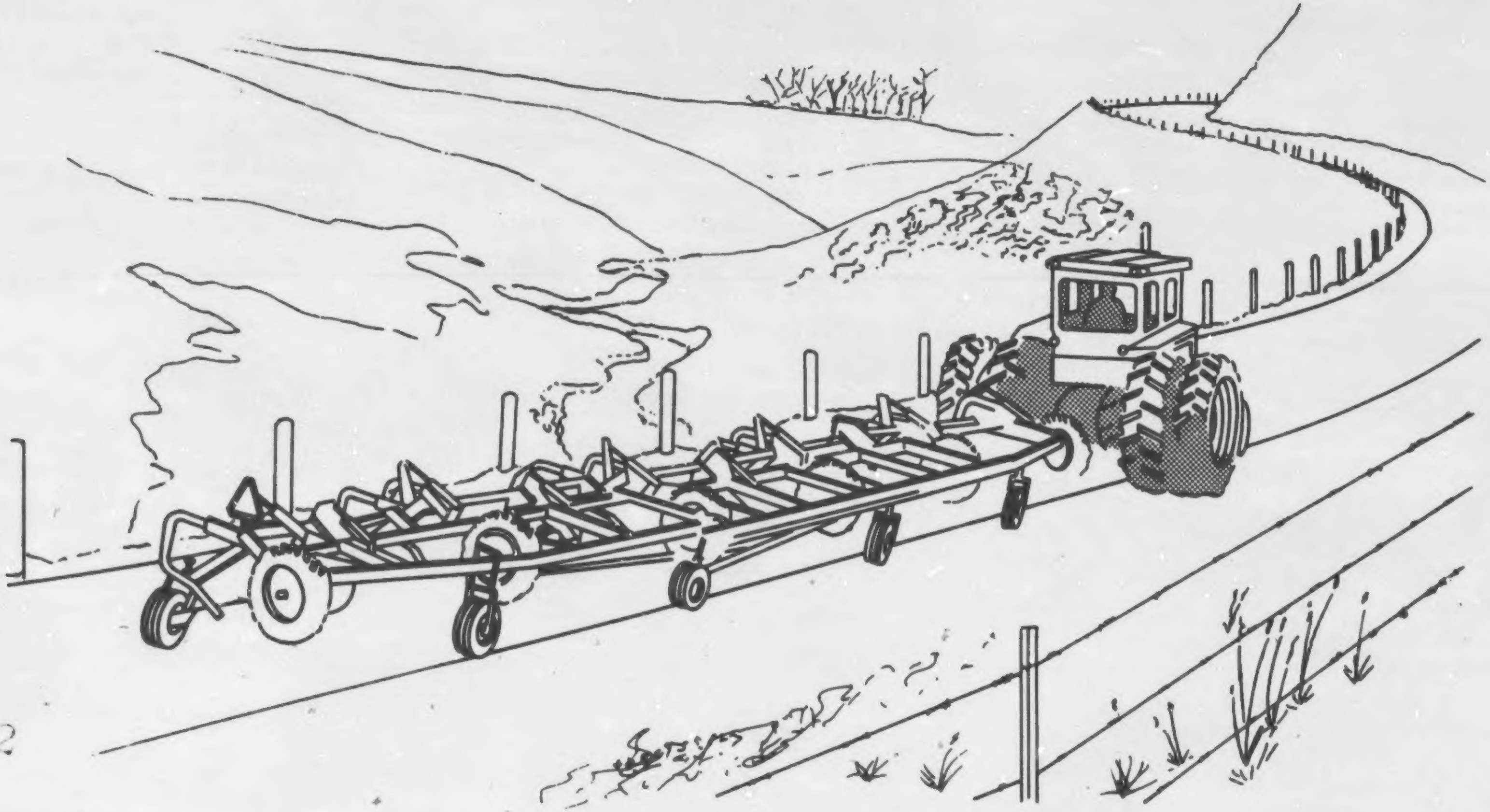




Slow Moving Vehicle Emblem
SMV


Reflective Red
14″
Fluorescent Orange
1¾″
16″

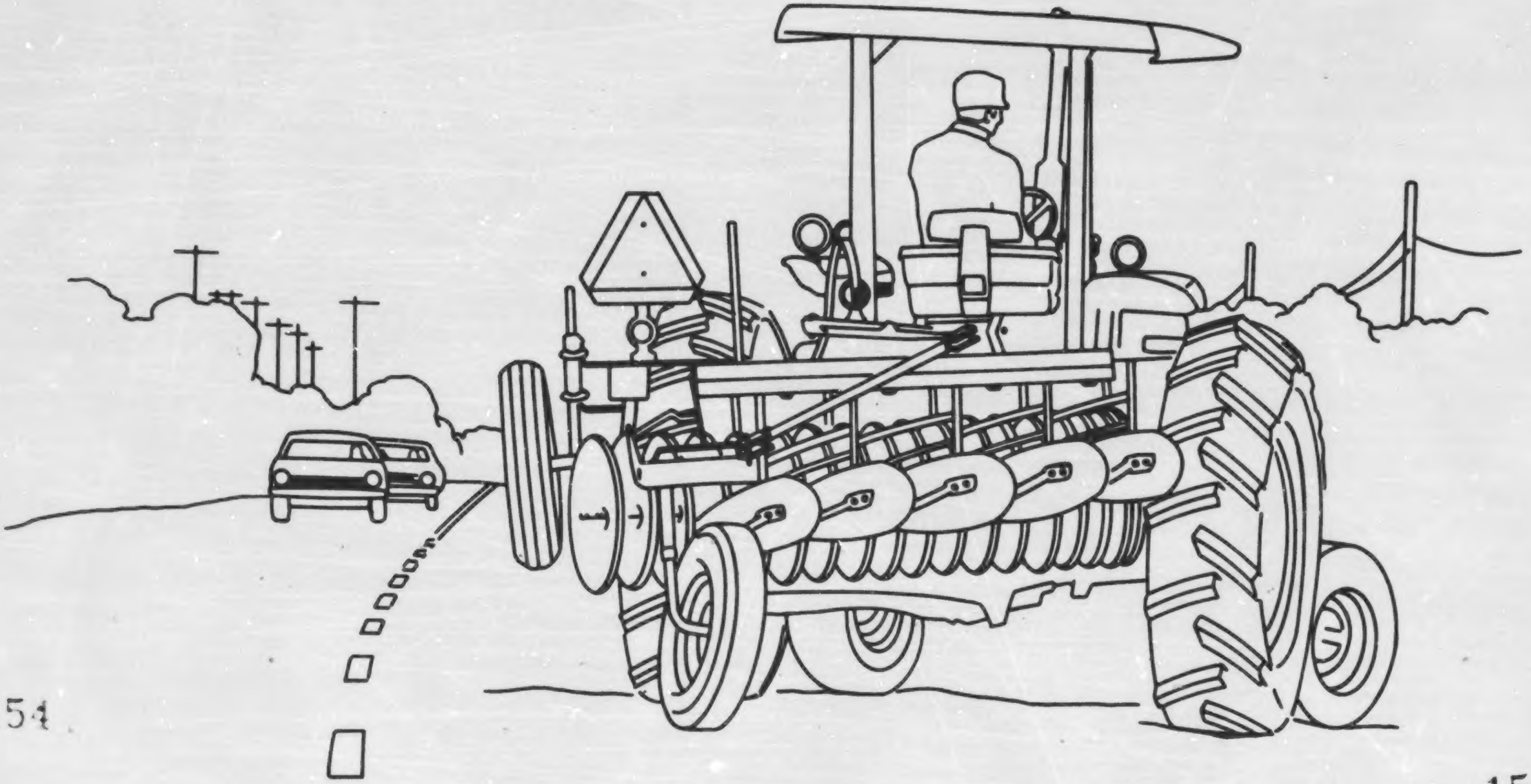
TRANSPORT SAFETY



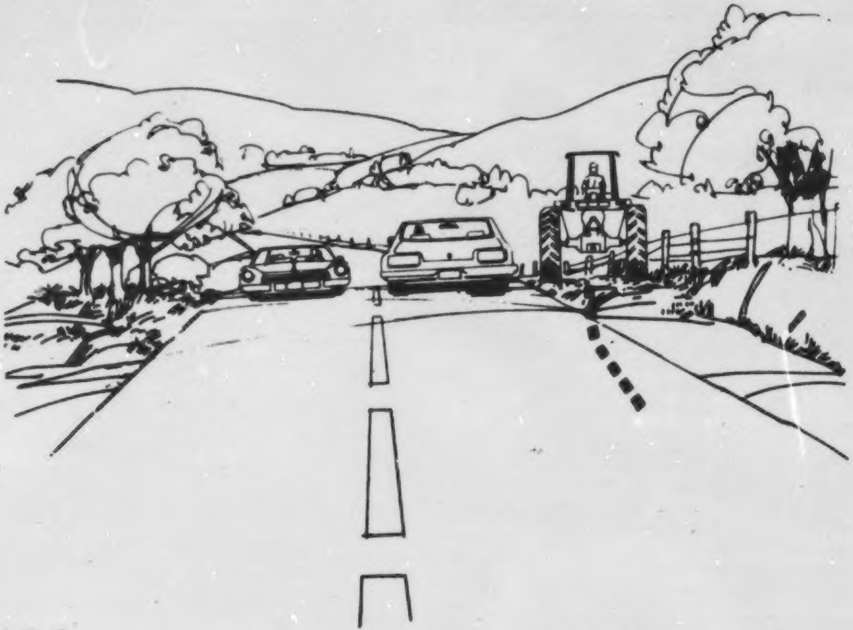
FM - 19-C

TM 3b

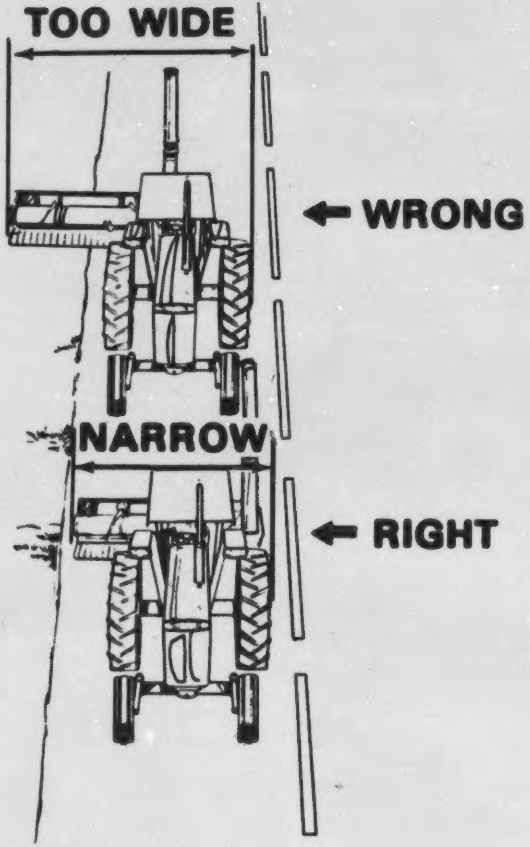
TRACTOR SAFETY AND TRANSPORT



BE COURTEOUS AT ALL TIMES



PULL OFF THE ROAD.
DON'T WAVE THEM PAST


TOO WIDE
← WRONG
NARROW
← RIGHT

TRACTOR SAFETY

ASSIGNMENT SHEET #1 - TRACTOR ACCIDENT SURVEY

Instructions: Using the form below, survey the community for accidents that involved a farm tractor.

Type of Accident	Number Involved	Age	Sex	Use of Vehicle
Tractor Upset				
Fall from Tractor				
Crushed				
Run Over				
Tractor in Transit				
PTO				
Other				

TRACTOR SAFETY

ANSWERS TO ASSIGNMENT SHEET

Assignment sheet #1

To the satisfaction of the instructor.

TRACTOR SAFETY

TEST

I. Match five terms associated with tractor safety.

___A. The condition of being safe from hurt, injury or loss.

___B. Any unplanned, unforseen or unexpected occurance of such a nature that personal injury, impairment of health or property damage may result there from, either directly or indirectly.

___C. One in which you failed to do everything you reasonably could have done to prevent it.

___D. One in which every possible thing was done to prevent the accident but still happened.

___E. A source of danger.

1. Safety
2. Accident
3. Preventable Accident
4. Non-Preventable Accident
5. Hazard

II. List the three steps to follow in prevention of accidents.

A.

B.

C.

III. Name five characteristice of a safe tractor operator.

A.

B.

C.

D.

E.

IV. List nineteen factors divided into four groups that can affect the operators capacity.

A.

1.
2.
3.
4.
5.
6.

B.

1.
2.
3.
4.

C.

1.
2.
3.
4.
5.

D.

1.
2.
3.
4.

V. List four safety steps taken before dismounting a tractor.

A.
B.
C.
D.

VI. Name six daily maintenance checks made before operating a tractor which could insure the operators safety.

A.

B.

C.

D.

E.

F.

VII. Draw and identify the two colors of the slow moving vehicle emblem. (SMV)

VIII. List three reasons why the SMV emblem is needed.

A.

B.

C.

IX. Name seven types of tractor accidents.

A.

B.

C.

D.

E.

F.

G.

X. Identify the two ways a tractor will upset.

A.

B.

XI. List twelve common surface hazards associated with tractor upsets.

A.

B.

C.

D.

E.

F.

G.

H.

I.

J.

K.

L.

XII. Name six safety precautions to avoid backward overturns of tractors.

A.

B.

C.

D.

E.

F.

XIII. Name four safety precautions to avoid side overturns of tractors.

A.

B.

C.

D.

XIV. Figure the center of gravity on a farm tractor weighing 15,000 lbs. with a 100" wheel base from point of front support to point of rear support.

NOTE: The rear of the tractor comprises 2/3 of the total tractor weight.

XV. List five causes of falls form tractors.

A.

B.

C.

D.

E.

XVI. Name seven safety precautions to prevent falls from tractors.

A.

B.

C.

D.

E.

F.

G.

XVII. List three problems encountered when slow and fast moving vehicles are using the same road.

A.

B.

C.

XVIII. Name nine highway safety rules.

A.

B.

C.

D.

E.

F.

G.

H.

I.

XIX. List four types of power take off (PTO) shields.

A.

B.

C.

D.

XX. Name eight safety precautions that could prevent PTO accidents.

A.

B.

C.

D.

E.

F.

G.

H.

XXI. List six types of clothes that should not be worn while working around PTO shafts.

A.

B.

C.

D.

E.

F.

XXII. List five steps involved in properly hitching a PTO drive line.

A.

B.

C.

D.

E.

XXIII. Name three elements that must be present in order to induce fire.

A.

B.

C.

XXIV. List five ways to reduce the possibility of fire on or around a tractor.

A.

B.

C.

D.

E.

TRACTOR SAFETY

ANSWERS TO TEST

I. A. 1

B. 2

C. 3

D. 4

E. 5

II. A. See the hazard

B. Know the defense

C. Act in time

III. A. Knowledge

B. Alertness

C. Foresight

D. Judgment

E. Skill

IV. A. Environmental

1. Temperature
2. Dust
3. Noise
4. Wind
5. Chemicals
6. Fumes

B. Personal

1. State of mind
2. Attitude
3. Concerns about other things

4. Goals, values, etc.

C. Job Consideration

1. Physical
2. Boredom
3. Fatigue
4. Hurrying
5. Co-Workers

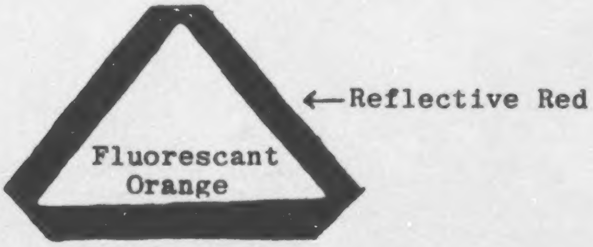
D. Home

1. Rest
2. Food
3. Environment
4. Daily breaks

V. A. Check PTO
B. Set brakes
C. Shut off engine
D. Leave shift in neutral or park position

VI. A. Fuel
B. Oil
C. Water
D. Hydraulic fluid
E. Tire inflation
F. Hydraulic hoses

VII.


←Reflective Red
Fluorescant Orange

VIII. A. For various farm vehicles to utilize public streets and highways.

B. For drivers of fast moving vehicles to recognize slow moving vehicles to avoid collisions.

C. To standardize the vehicle as slow moving type vehicle (less than 25 mph).

IX. A. Tractor upsets

B. Falls from tractors

C. Crushed by tractors

D. Run over by tractors

E. Motor-vehicle collision

F. PTO accidents

G. Fire

X. A. Backward

B. Sideways

XI. A. Speed

B. Crossing slopes

C. Uphill

D. Downhill

E. Ditches

F. High hitches

G. Public roads

H. Loads on front

I. Loads on drawbar

J. Hidden obstacles

K. Mud

L. Misuse

XII. A. Keep the hitch low

B. Back up steep inclines or slopes

C. Engage clutch slowly

D. Avoid any condition that could cause the front of the tractor to lift off the ground.

E. Keep a sufficient amount of weights on the front of the tractor.

F. Don't chain blocks to rear wheel when stuck.

XIII. A. Don't drive too fast.

B. Avoid turning sharp.

C. Keep front loads low when moving.

D. Don't drive close to ditches.

XIV.

$$B = \frac{W2}{W_1 + W_2} \quad B_1$$

$$B = \frac{5000}{10,000 + 5000} \quad 100$$

$$B = 33.3$$

XV. A. Slippery surfaces

B. Cluttered platforms

C. Failure to use hand holds and steps

D. Rough ground

E. Overhead obstructions

XVI. A. No rider on tractor.

B. Use hand and foot aids for mounting and dismounting.

C. Step off tractor only when stopped.

D. Keep platform clean.

E. Avoid riding on fenders and drawbars.

F. Slow down when crossing rough ground.

G. Keep alert for overhead obstructions.

XVII. A. Stopping vehicle as the faster vehicle approaches the slower vehicle.

B. Identification of the vehicle as moving slow.

C. Size of the slow moving vehicle presents difficulty in seeing dangers ahead.

XVIII. A. Use right lane or shoulder.

B. Be courteous, pull off the road and allow cars to pass.

C. Use turn signals and warning flashers.

D. Use required vehicle lighting.

E. Use SMV (Slow Moving Vehicle) clean and visible.

F. Obey all traffic rules.

G. Slow down for sharp curves.

H. Reduce engine speed going downhill.

I. Beware of blind intersections.

XIX. A. Master shield

B. Tunnel shield

C. Journaled shield

D. Fully shielded

XX. A. Use PTO shields

B. Wear tight fitting clothes and keep hands and feet from PTO.

C. Disengage PTO when dismounting or not in use.

D. Keep work area clean.

E. Never allow riders to ride on the drawbar of a tractor.

F. Never hook 540 RPM equipment to 1000 RPM, PTO or visa versa.

G. Do not service or perform work on a machine without first disengaging the PTO and shutting off the tractor engine.

H. Always be sure PTO is properly attached.

XXI. A. Ties or scarves

B. Loose sleeves

C. Loose pants

D. Cuffs

E. Loose jackets

F. Gloves

XXII. A. Disengage all power

B. Shut off engine

C. Wait until PTO shaft stops turning

D. Keep all shields in place

E. Keep drawbar in proper position in relation to the PTO shaft.

XXIII. A. Air

B. Heat

C. Fuel

XXIV. A. Shut off and allow tractor to cool before refueling.

B. Check fuel system for leaks and damage.

C. Do not smoke while refueling.

D. Keep tractor and equipment free from chaff and grease.

E. Keep a fire extinguisher on tractor.

UNIT VI

TRACTOR OPERATION

TRACTOR OPERATION

TERMINAL OBJECTIVE

The student, upon completion of Unit VI, should understand the principles of operation and functions of various parts of a tractor. This knowledge will be evidenced through demonstration and by scoring at least eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

I. List fourteen major controls and operating instruments on a tractor.

II. List sixteen major symbols for controls and operating instruments on a tractor.

III. Name six intervals that service jobs must be performed.

IV. Name four adjustments the operator must check or make before operation.

V. Name five areas that an operator must be familiar with before operating equipment is hitched to a tractor.

VI. List six basic operational procedures for developing good judgement on safety and efficient tractor operation under field condition.

VII. List twelve problems to be aware of during field or highway operation of a tractor.

VIII. Identify fourteen major controls and operating instruments.

IX. Identify sixteen different control symbols.

X. Identify basic parts of a tractor.

TRACTOR OPERATION

SUGGESTED ACTIVITIES

I. Instructor:

- A. Provide students with terminal and specific objectives, information sheets and job sheets.
- B. Discuss the principles of operation concerning tractor operation.
- C. Discuss the types of tractors used in your area.
- D. Schedule a field trip to a farm equipment dealer to view the various types of tractors.
- E. Demonstrate procedures on job sheets.
- F. Give test.

II. Student:

- A. Study information sheets provided by the instructor.
- B. Demonstrate the ability to perform the jobs listed on job sheets.
- C. Take test.

INSTRUCTIONAL MATERIALS

I. Materials included in this unit:

- A. Objectives
- B. Information sheets
- C. Transparency masters
  1. TM 1 - Control and Operating Instruments
  2. TM 2 - Symbols for Operating Controls and Instruments
  3. TM 3 - Sample Lubrication Chart
  4. TM 4a- Attaching Rear-Mounted Equipment

     TM 4b- Attaching Rear-Mounted Equipment

TM 4c- Attaching Rear-Mounted Equipment

5. TM 5 - Attaching Remote Hydraulic Cylinders

6. TM 6 - How Do You Respond To:

7. TM 7 - Parts of a Tractor

D. Job sheets

1. Job sheet #1 - Locate and Identify Operating Controls

2. Job sheet #2 - Identify Control Symbols

3. Job sheet #3 - Locate and Identify Parts of a Tractor

E. Test

F. Answers to test

II. References:

A. Fundamentals of Machine Operation-Tractors, Moline, Illinois, Deere and Co., 1974.

B. John Deere Operator Manuals, John Deere and Co.

C. Case Operator Manuals, J.I. Case Co.

D. Tractor Operation and Daily Care, Athens, Georgia, AAVIM, Engineer Center.

TRACTOR OPERATION

INFORMATION SHEET

I. Fourteen major control and operating instruments on a tractor. TM 1

  A. Clutch Pedal

  B. Light Switch

  C. Fuel Shut-off

  D. PTO Clutch

  E. Engine Oil Pressure

  F. Ammeter

  G. Fuel Gauge

  H. Temperature Gauge

  I. Speed Indicator

  J. Shift Lever

  K. Throttle Control

  L. Remote Hydraulic Levers

  M. Brake Pedals

  N. Ignition Switch

II. Sixteen major symbols for controls and operating instruments on a tractor. TM 2

  A. Engine Oil Pressure

  B. Engine RPM

  C. Choke

  D. Air Filter

  E. Water Temperature

  F. Ammeter

  G. Fuel

INFORMATION SHEET

- H. Fuel Take-off
- I. Power Take-off
- J. Remote Cylinder
- K. Rock Shaft
- L. Speed Range
- M. Lights
- N. Neutral
- O. Park
- P. Implement Movement

III. Six intervals that service jobs must be performed. TM 3

- A. Once a day
- B. 50 hours or once a week
- C. 100 hours or every two weeks
- D. 250 hours or monthly
- E. 500 hours or twice a year
- F. 1000 hours or once a year

IV. Four adjustments the operator must check or make before operation.

- A. Tire pressure
- B. Weight for Traction
- C. Front and rear wheel spacing
- D. Seat adjustment

V. Five areas that an operator must be familiar with before operating equipment is hitched to a tractor.

NOTE: Refer to Operators Manual if in doubt.

- A. Properly attaching equipment to drawbar.
- B. Properly hitching rear mounted equipment. TM 4

INFORMATION SHEET

C. Proper connection of PTO

D. Proper connection of remote hydraulic cylinder. TM 5

E. Properly hitching belt driven equipment.

VI. Six basic operational procedures for developing good judgement on safety and efficient tractor operation under field conditions.

A. Make adjustments before starting field work.

B. Matching gear selection and engine speed with load.

C. Handling overloads without stopping tractor.

D. Checking tire slippage.

E. Operation of tractors on slopes.

F. Pulling out of ditches or mud holes.

VII. Twelve problems to be aware of during field or highway operation of a tractor. TM 6

A. Precautions when dismounting

B. Checking instruments and gauges

C. Riding tractor drawbar

D. Operating in wet conditions

E. Gear selection

F. Overloading

G. Operating near ditches and on slopes

H. Turning

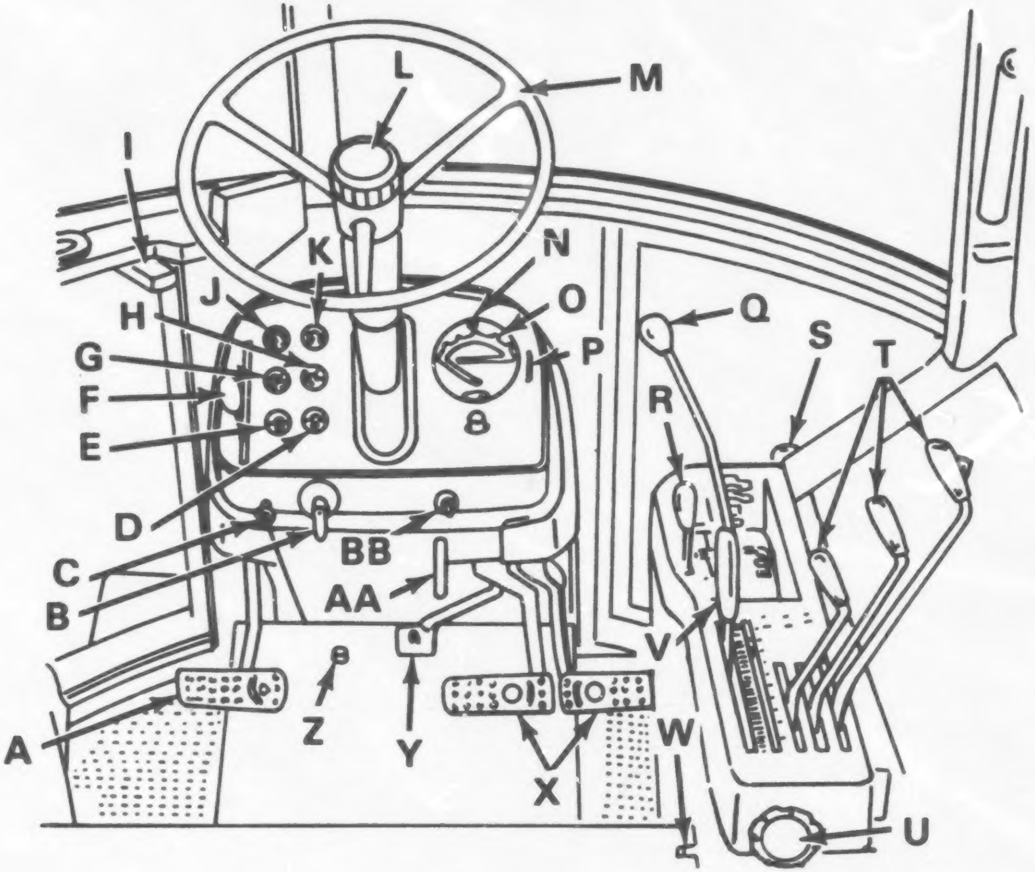
I. Transportation of equipment on highways

J. Using proper lighting and SMV emblem

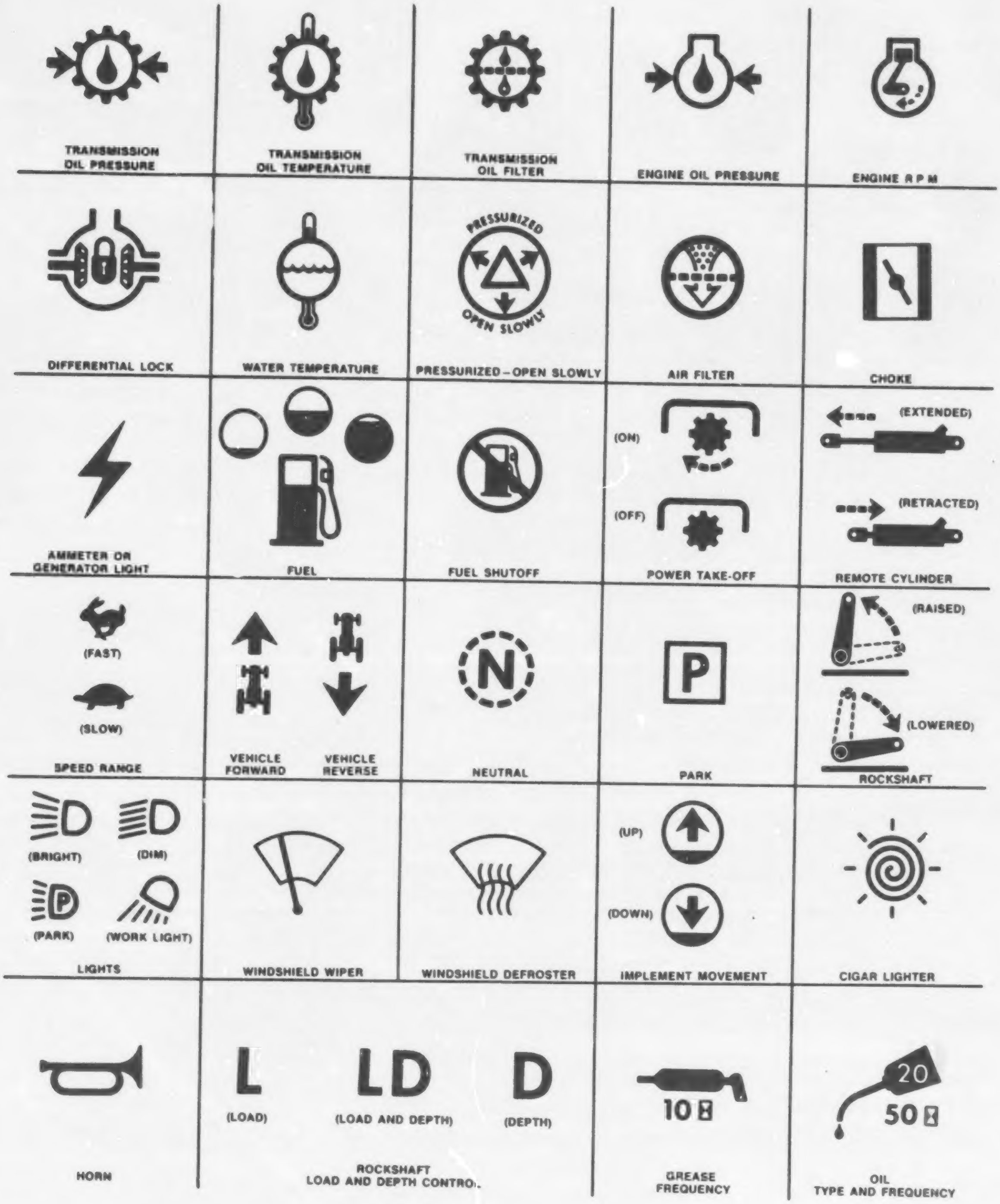
K. Operating PTO equipment

L. Watching equipment during operation

MAJOR CONTROLS AND INSTRUMENTS


M
L
I
K
N
J
O
H
Q
G
P
S
T
F
R
E
D
C
BB
B
AA
V
A
Z
Y
X
W
U

SYMBOLS FOR OPERATING CONTROLS AND INSTRUMENTS


TRANSMISSION OIL PRESSURE
TRANSMISSION OIL TEMPERATURE
TRANSMISSION OIL FILTER
ENGINE OIL PRESSURE
ENGINE R P M
DIFFERENTIAL LOCK
WATER TEMPERATURE
PRESSURIZED
OPEN SLOWLY
PRESSURIZED – OPEN SLOWLY
AIR FILTER
CHOKE
AMMETER OR GENERATOR LIGHT
FUEL
FUEL SHUTOFF
(ON)
(OFF)
POWER TAKE-OFF
(EXTENDED)
(RETRACTED)
REMOTE CYLINDER
(FAST)
(SLOW)
SPEED RANGE
VEHICLE FORWARD
VEHICLE REVERSE
N
NEUTRAL
P
PARK
(RAISED)
(LOWERED)
ROCKSHAFT
(BRIGHT)
(DIM)
P
(PARK)
(WORK LIGHT)
LIGHTS
WINDSHIELD WIPER
WINDSHIELD DEFROSTER
(UP)
(DOWN)
IMPLEMENT MOVEMENT
CIGAR LIGHTER
HORN
L
(LOAD)
LD
(LOAD AND DEPTH)
D
(DEPTH)
ROCKSHAFT LOAD AND DEPTH CONTROL
10
GREASE FREQUENCY
20
50
OIL TYPE AND FREQUENCY

SAMPLE LUBRICATION CHART

LUBRICATION INTERVAL CHART AND DIAGRAM FOR FARM TRACTORS

LUBRICATION INTERVAL	SYMBOL*
5 HOURS	△
10 HOURS	○
50 HOURS	□
100 HOURS	◡
250 HOURS	▱
500 HOURS	▭
1000 HOURS	⬡
2000 HOURS	⏢

*OPTIONAL

LUBRICATION CHART

TRACTOR, WHEEL TYPE

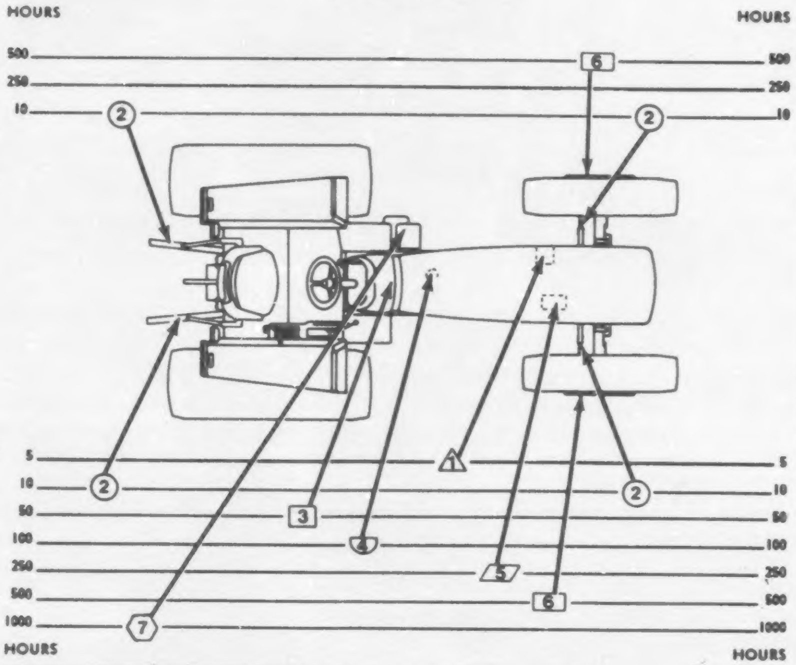
INTERVAL HOURS	POINT	IDENTIFICATION	LUBRICANT
5	1-ORANGE	AIR CLEANER	E.O.
10	2-RED	STEERING MECHANISM, LIFT MECHANISM	M.P.G.
50	3-YELLOW	CLUTCH THROW-OUT BEARING	M.P.G.
100	4-GREEN	ENGINE OIL CHANGE	E.O.
250	5-BLUE	STEERING GEAR HOUSING CHECK GENERATOR BEARINGS, DISTRIBUTOR	E.O.
500	6-WHITE	REPACK FRONT WHEEL BEARINGS	M.P.G.
1000	7-BROWN	TRANSMISSION OIL CHANGE TORQUE TUBE OIL CHANGE POWER STEERING RESERVOIR	M.P.L. E.O. SPEC. O

LUBRICANT ABBREVIATIONS

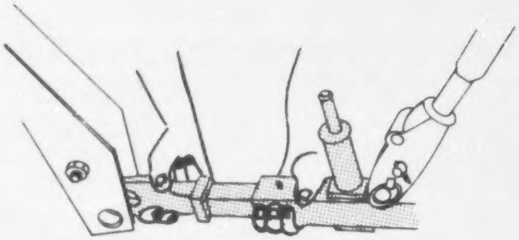
E.O.	ENGINE OIL
M.P.G.	MULTIPURPOSE-TYPE GREASE
M.P.L.	MULTIPURPOSE-TYPE GEAR LUBRICANT
SPEC. O	AUTOMATIC TRANSMISSION FLUID — TYPE A

LUBRICATION CHART DIAGRAM

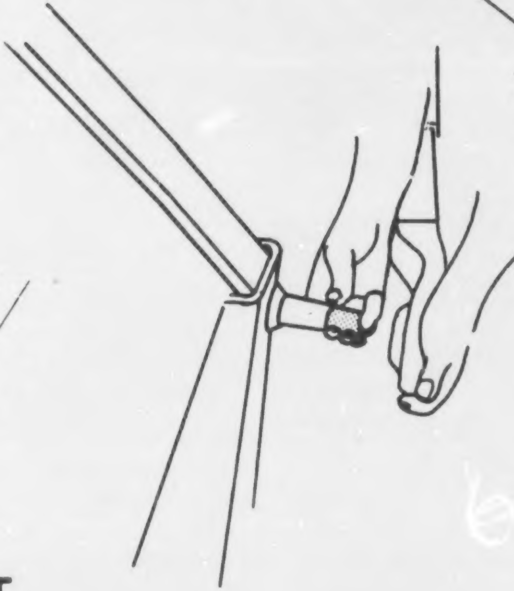
SERVICE INTERVALS



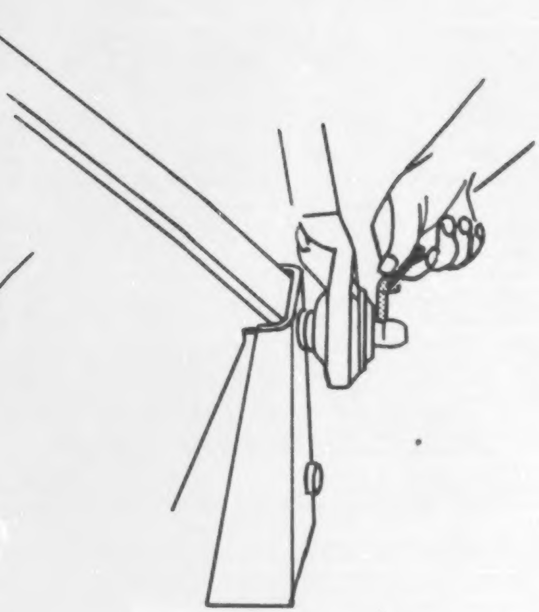
ATTACHING REAR-MOUNTED EQUIPMENT



ATTACH LEFT DRAFT LINK FIRST

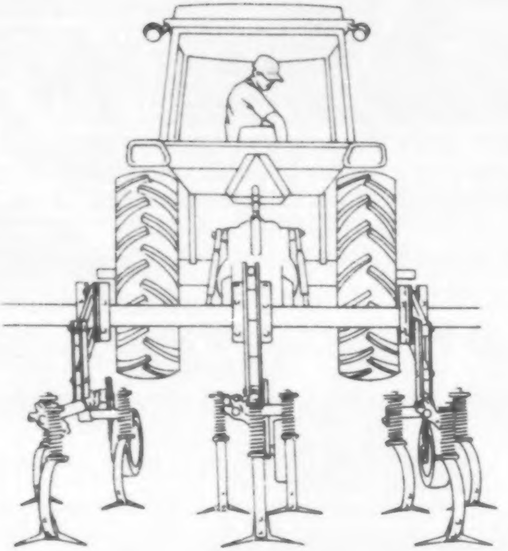


INSTALL BUSHINGS IF NEEDED

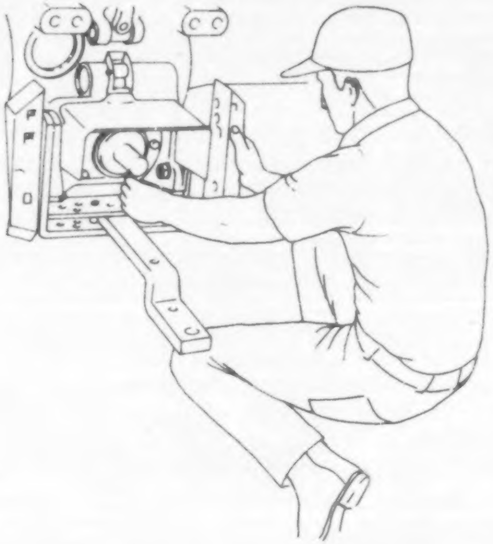


INSERT LOCKING PIN

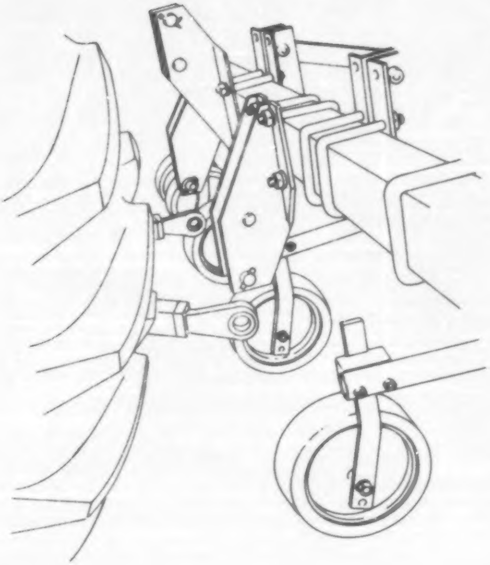
ATTACHING REAR-MOUNTED EQUIPMENT



BACK SLOWLY

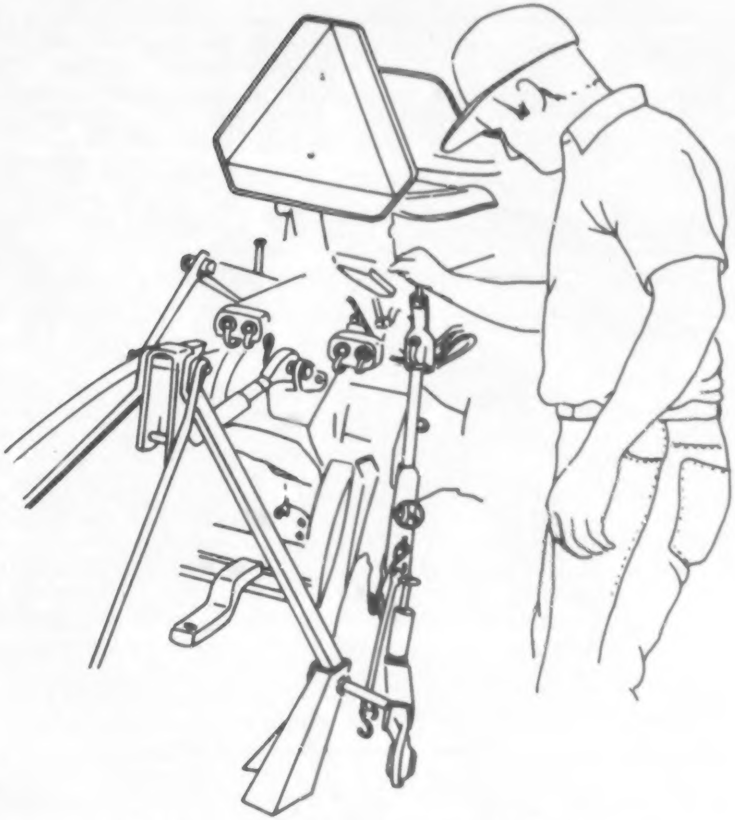


ADJUST SWAY BLOCKS

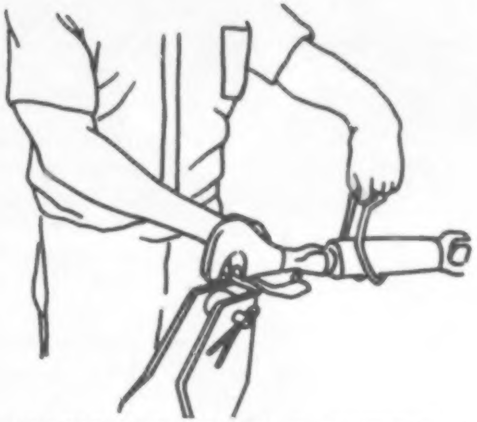


POSITION LIFT ARMS

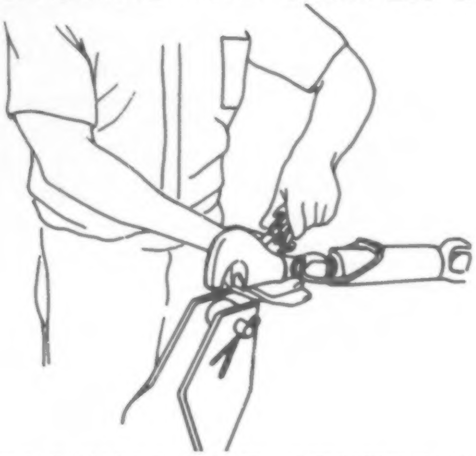
ATTACHING REAR-MOUNTED EQUIPMENT



ADJUSTING RIGHT ARM FOR CONNECTION

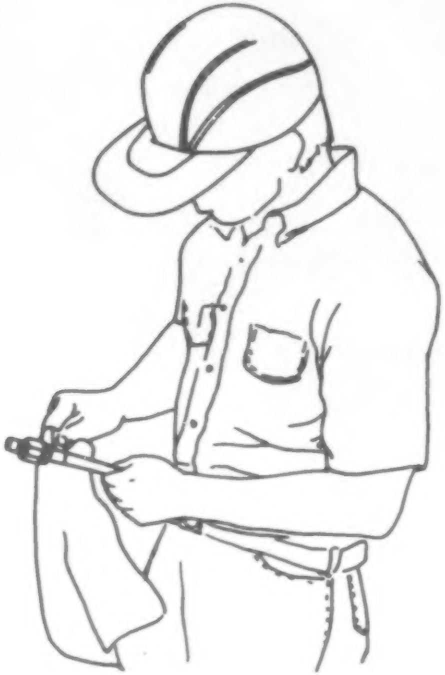


ADJUSTING THE CENTER LINK

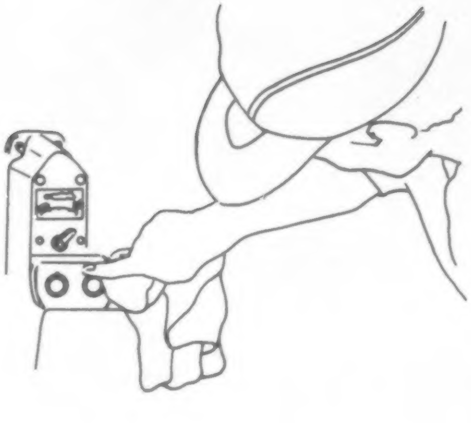


ATTACHING THE CENTER LINK

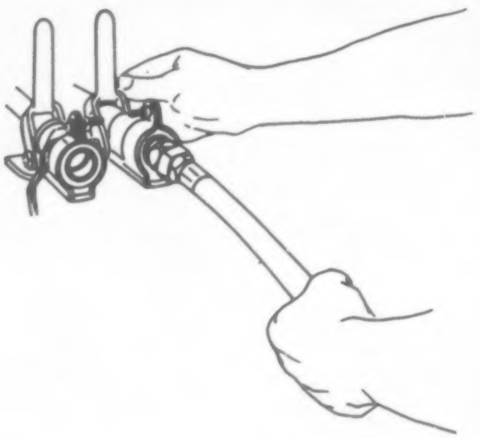
ATTACHING REMOTE HYDRAULIC CYLINDERS



CLEAN HOSES



CLEAN PORTS



ATTACH
HYDRAULIC LINE

HOW DO YOU RESPOND TO:

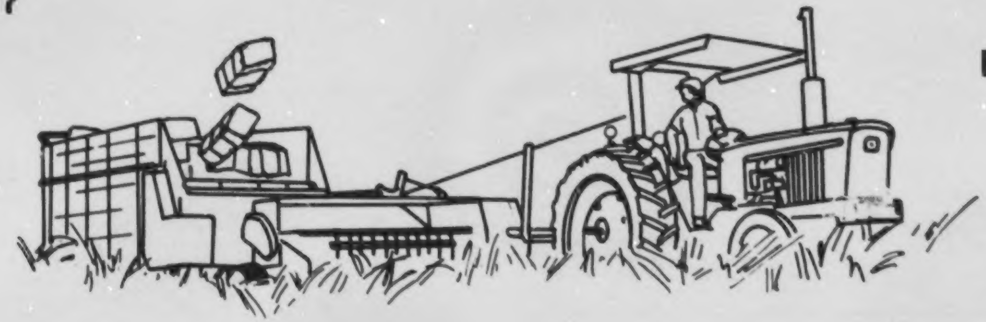
WET CONDITIONS?

STARTING HEAVY LOADS?

STARTING LIGHT LOADS?

OPERATING PTO EQUIPMENT?

DRIVING THE TRACTOR?



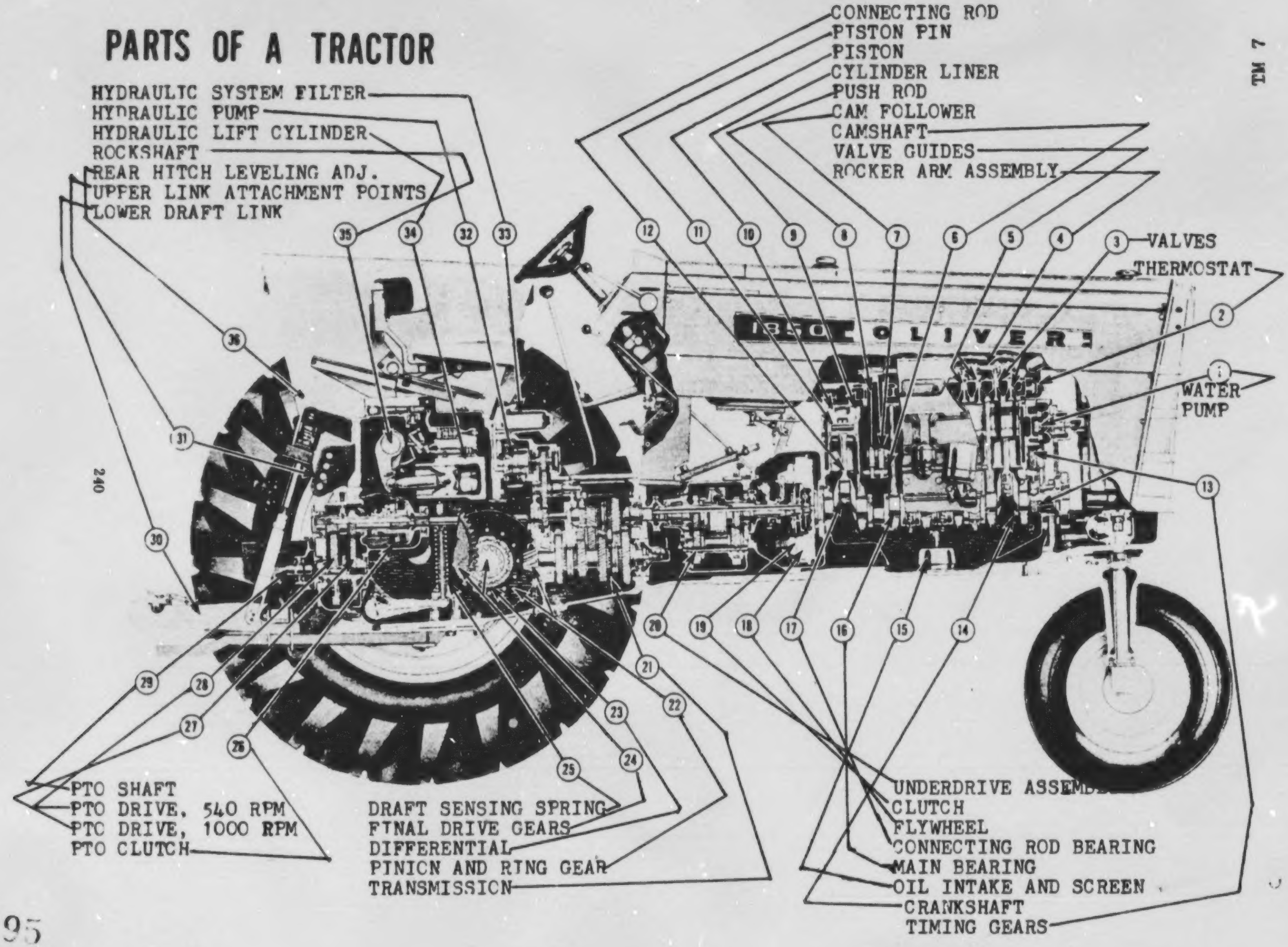
SLOPES?

STARTING PTO EQUIPMENT?

WATCHING EQUIPMENT?

GEAR SELECTION?

PARTS OF A TRACTOR


HYDRAULIC SYSTEM FILTER
HYDRAULIC PUMP
HYDRAULIC LIFT CYLINDER
ROCKSHAFT
REAR HITCH LEVELING ADJ.
UPPER LINK ATTACHMENT POINTS
LOWER DRAFT LINK
CONNECTING ROD
PISTON PIN
PISTON
CYLINDER LINER
PUSH ROD
CAM FOLLOWER
CAMSHAFT
VALVE GUIDES
ROCKER ARM ASSEMBLY
VALVES
THERMOSTAT
WATER PUMP
1850 OLIVER
PTO SHAFT
PTO DRIVE, 540 RPM
PTO DRIVE, 1000 RPM
PTO CLUTCH
DRAFT SENSING SPRING
FINAL DRIVE GEARS
DIFFERENTIAL
PINION AND RING GEAR
TRANSMISSION
UNDERDRIVE ASSEMBLY
CLUTCH
FLYWHEEL
CONNECTING ROD BEARING
MAIN BEARING
OIL INTAKE AND SCREEN
CRANKSHAFT
TIMING GEARS
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36

TRACTOR OPERATION

JOB SHEET #1 - LOCATE AND IDENTIFY OPERATING CONTROLS

I. Tools and equipment needed:

Copy of an operators manual for tractors provided by your instructor.

II. Procedure:

Using the copy of the operators manual, locate and identify the controls and instruments of a tractor.

TRACTOR OPERATION

JOB SHEET #2 - IDENTIFY CONTROL SYMBOLS

I. Tools and materials needed:

   A. Copy of operators manual for tractor provided by instructor.

   B. Copy of transparency master #2.

II. Procedure:

   A. Using the operators manual and transparency master #2, identify the control symbols on the tractor provided by the instructor.

TRACTOR OPERATION

JOB SHEET #3 - LOCATE AND IDENTIFY PARTS OF A TRACTOR

I. Tools and equipment needed:

A. Copy of transparency master #7.

B. Tractor provided by instructor.

II. Procedure:

Using the copy of transparency master #7 and a tractor, locate and identify each of the parts on a tractor.

TRACTOR OPERATION

TEST

I. List fourteen major controls and operating instruments on a tractor.

A.

B.

C.

D.

E.

F.

G.

H.

I.

J.

K.

L.

M.

N.

II. List sixteen major symbols for controls and operating instruments on a tractor.

A.

B.

C.

D.

E.

F.

G.

H.

I.

J.

K.

L.

M.

N.

O.

P.

III. Name six intervals that service jobs must be performed.

A.

B.

C.

D.

E.

F.

IV. Name four adjustments the operator must check or make before operation.

A.

B.

C.

D.

V. Name five areas than an operator must be familiar with before operating equipment is hitched to a tractor.

A.

B.

C.

D.

E.

VI. List six basic operational procedures for developing good judgement on safety and efficient tractor operation under field conditions.

A.

B.

C.

D.

E.

F.

VII. List twelve problems to be aware of during field or highway operation of a tractor.

A.

B.

C.

D.

E.

F.

G.

H.

I.

J.

K.

L.

TRACTOR OPERATION

ANSWERS TO TEST

I. A. Clutch Pedal
B. Light Switch
C. Fuel Shut-off
D. PTO Clutch
E. Engine Oil Pressure
F. Ammeter
G. Fuel Gauge
H. Temperature Gauge
I. Speed Indicator
J. Shift Lever
K. Throttle Control
L. Remote Hydraulic Levers
M. Brake Pedals
N. Ignition Switch

II. A. Engine Oil Pressure
B. Engine RPM
C. Choke
D. Air Filter
E. Water Temperature
F. Ammeter
G. Fuel
H. Fuel Shut-off
I. Power Take-off
J. Remote Cylinder
K. Rock Shaft
L. Speed Range
M. Lights
N. Neutral
O. Park
P. Implement Movement

III. A. Once a day
B. 50 hours or once a week
C. 100 hours or every two weeks
D. 250 hours or monthly
E. 500 hours or twice a year
F. 1000 hours or once a year

IV. A. Tire Pressure
B. Weight for Traction
C. Front and rear wheel spacing

D. Seat Adjustment

V. A. Properly attaching equipment to drawbar.

B. Properly hitching rear mounted equipment.

C. Proper connection of PTO.

D. Proper connection of remote hydraulic cylinder.

E. Properly hitching belt driven equipment.

VI. A. Make adjustments before starting field work.

B. Matching gear selection and engine speed with load.

C. Handling overloads without stopping tractor.

D. Checking tire slippage.

E. Operation of tractors on slopes.

F. Pulling out of ditches or mud holes.

VII. A. Precautions when dismounting

B. Checking instruments and gauges

C. Riding tractor drawbar

D. Operating in wet conditions

E. Gear selection

F. Overloading

G. Operating near ditches and on slopes

H. Turning

I. Transportation of equipment on highways

J. Using proper lighting and SMV emblem

K. Operating PTO equipment

L. Watching equipment during operation

UNIT VII

PREVENTIVE MAINTENANCE

PREVENTIVE MAINTENANCE

TERMINAL OBJECTIVE

Upon completion of Unit VII, the student should understand the importance of preventive maintenance and demonstrate the ability to maintain a tractor in an operational condition. This knowledge will be evidenced through demonstration and by scoring at least eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

I. List three effects of good maintenance.

II. Name four service jobs performed once a day.

III. List four service jobs performed every 50 hours or once a week.

IV. List four service jobs performed every 100 hours or every two weeks.

V. Name five service jobs performed every 250 hours or monthly.

VI. List four service jobs performed every 500 hours or twice a year.

VII. Name two service jobs performed every 1000 hours or once a year.

VIII. Demonstrate the ability to:

  A. Service an oil bath air cleaner.

  B. Change oil and filter on a tractor engine.

  C. Change the spark plugs on a tractor engine.

  D. Adjust the carburetor of a tractor engine.

  E. Change the points and condensers in a distributor.

  F. Change diesel fuel filters.

PREVENTIVE MAINTENANCE

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with terminal and specific objectives, information sheets and job sheets.

   B. Discuss the importance of preventive maintenance.

   C. Make transparencies.

   D. Demonstrate the procedures on job sheets.

   E. Give test.

II. Student:

   A. Study information sheets provided by instructor.

   B. Demonstrate the ability to perform the jobs listed on the job sheets.

   C. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objectives

   B. Information sheets

   C. Transparency masters

      1. TM 1 - Lubrication Interval Chart

      2. TM 2 - Check Engine Oil Level Daily

      3. TM 3 - Power Lift

      4. TM 4 - Changing Crankcase Oil

      5. TM 5 - Proper Tire Pressure

      6. TM 6 - Adjustments on Gasoline Carburetor

      7. TM 7 - Typical Clutch Operation

      8. TM 8 - Types of Brake Systems
      9. TM 9 - How to Adjust Distributor
      10. TM 10- Servicing Wheel Bearings

   D. Job sheets

      1. Job sheet #1 - Servicing Oil Bath Air Cleaner
      2. Job sheet #2 - Changing Engine Oil and Filter
      3. Job sheet #3 - Changing Spark Plugs
      4. Job sheet #4 - Adjusting the Carburetor
      5. Job sheet #5 - Changing Points and Condenser
      6. Job sheet #6 - Changing Diesel Fuel Filter

   E. Test

   F. Test answers

II. References:

   A. John Deere Operators Manuals, John Deere and Co.

   B. Fundamentals of Machine Operation Tractors, Moline, Illinois, Deere and Co., 1974.

   C. Fundamentals of Machine Operation Preventive Maintenance, Moline, Illinois, John Deere and Co., 1974.

   D. Tractor Maintenance Principles and Procedures, Athens, Georgia, American Association for Vocational Instructional Materials, 1970.

PREVENTIVE MAINTENANCE

INFORMATION SHEET

I. Three effects of good maintenance. TM 1

- A. Reduces equipment failures
- B. Reduces operating cost
- C. Reduces safety hazards

II. Four service jobs performed once a day.

- A. Air cleaner
- B. Check engine oil TM 2
- C. Coolant level
- D. Tire pressure

III. Four service jobs performed every 50 hours on once a week.

- A. Steering
- B. Lift mechanism TM 3
- C. Battery maintenance
- D. Checking hydraulic oil level

IV. Four service jobs performed every 100 hours or every two weeks.

- A. Clutch release bearing
- B. Changing oil and filter TM 4
- C. Servicing crankcase breather
- D. Tire maintenance TM 5

V. Five service jobs performed every 250 hours or monthly.

- A. Checking valve clearance
- B. Changing spark plugs
- C. Adjusting the carburetor TM 6

INFORMATION SHEET

D. Adjusting clutch TM 7

E. Adjusting brakes TM 8

VI. Four service jobs performed every 500 hours or twice a year.

A. Servicing the distributor TM 9

B. Checking time

C. Servicing diesel engine fuel filters

D. Packing front wheel bearings TM 10

VII. Two service jobs performed every 1000 hours or once a year.

A. Cleaning the tractor

B. Service air cleaner assembly

LUBRICATION INTERVAL	SYMBOL*
5 HOURS	△
10 HOURS	○
50 HOURS	□
100 HOURS	◡
250 HOURS	▱
500 HOURS	▭
1000 HOURS	⬡
2000 HOURS	⏢

*OPTIONAL

LUBRICATION INTERVAL CHART AND DIAGRAM FOR TRACTORS AND FARM MACHINERY

LUBRICATION CHART

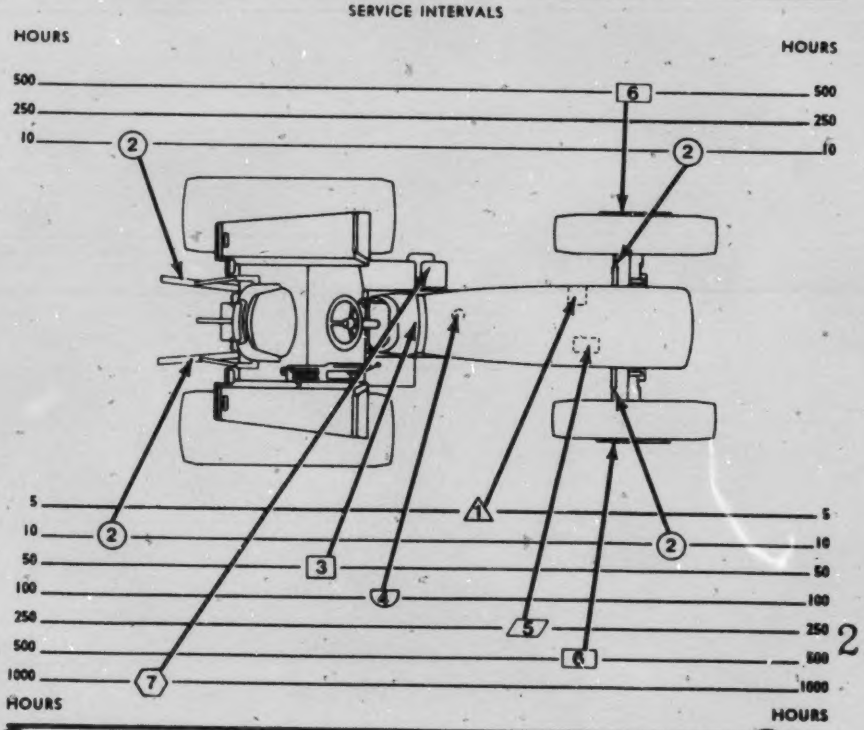
TRACTOR, WHEEL TYPE

INTERVAL HOURS	POINT	IDENTIFICATION	LUBRICANT
5	1-ORANGE	AIR CLEANER	E.O.
10	2-RED	STEERING MECHANISM, LIFT MECHANISM	M.P.G.
50	3-YELLOW	CLUTCH THROW-OUT BEARING	M.P.G.
100	4-GREEN	ENGINE OIL CHANGE	E.O.
250	5-BLUE	STEERING GEAR HOUSING CHECK GENERATOR BEARINGS, DISTRIBUTOR	E.O.
500	6-WHITE	REPACK FRONT WHEEL BEARINGS	M.P.G.
1000	7-BROWN	TRANSMISSION OIL CHANGE TORQUE TUBE OIL CHANGE POWER STEERING RESERVOIR	M.P.L. E.O. SPEC. O

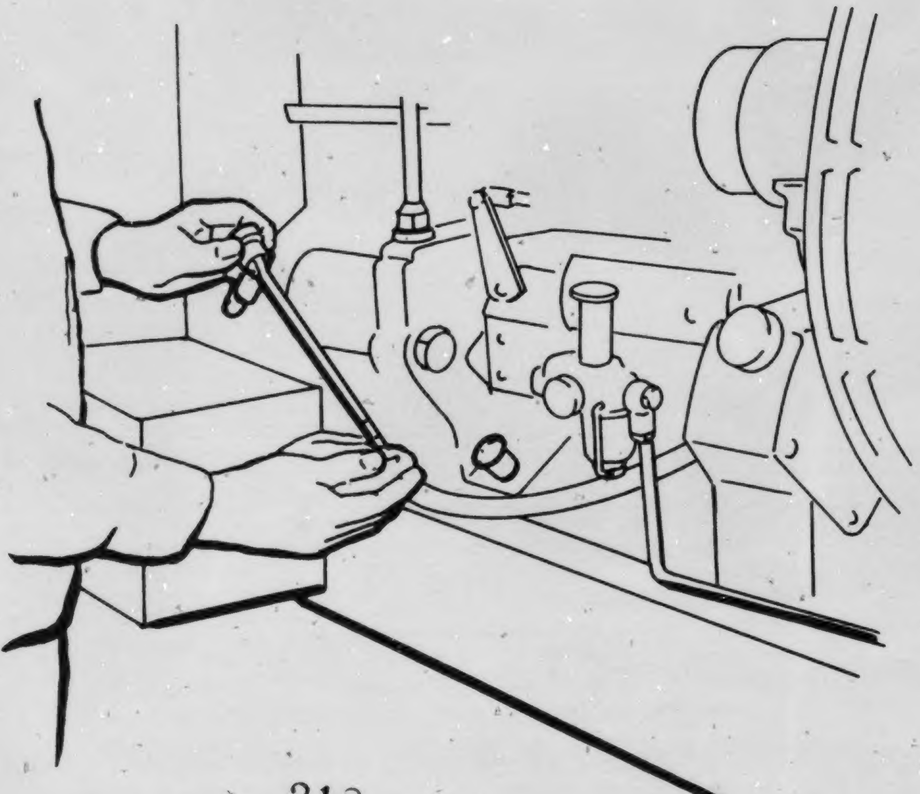
LUBRICANT ABBREVIATIONS

E.O.	ENGINE OIL
M.P.G.	MULTIPURPOSE-TYPE GREASE
M.P.L.	MULTIPURPOSE-TYPE GEAR LUBRICANT
SPEC. O	AUTOMATIC TRANSMISSION FLUID — TYPE A

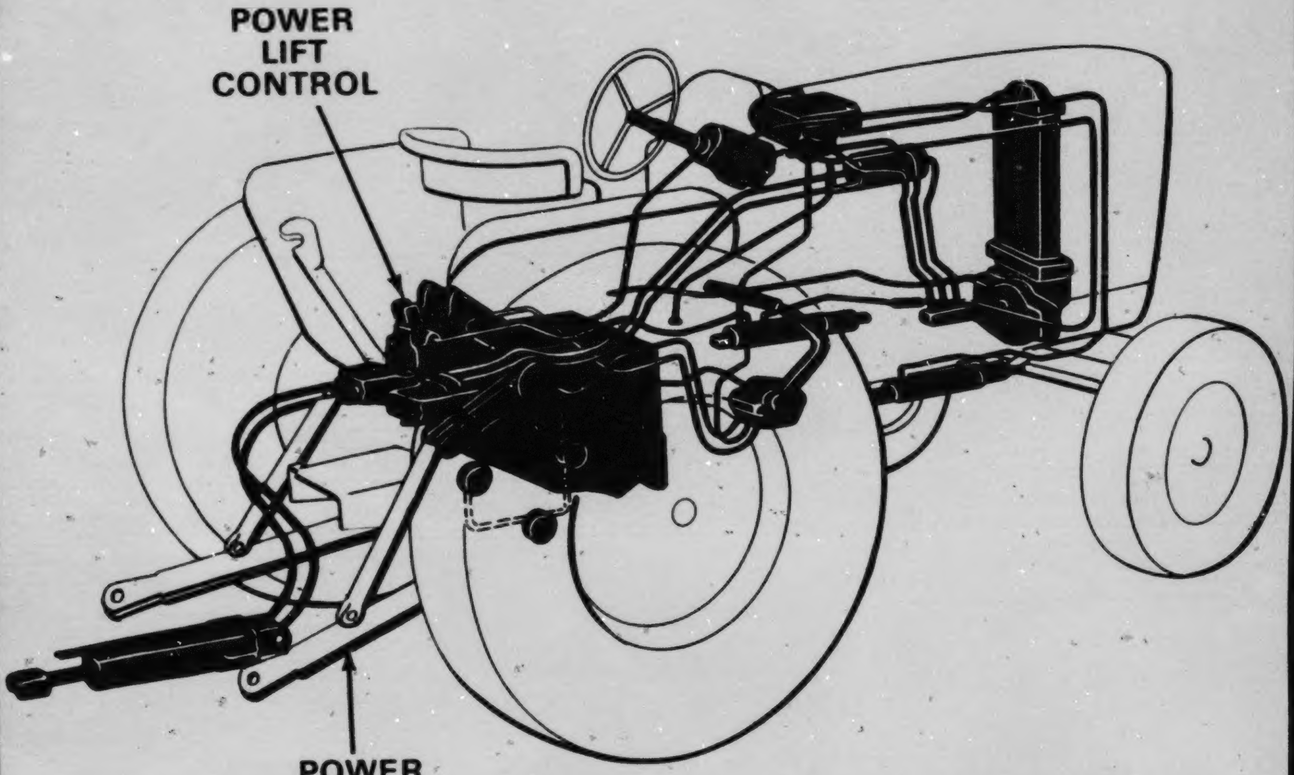
LUBRICATION CHART DIAGRAM


SERVICE INTERVALS
HOURS
HOURS
500
250
10
6
2
2
500
250
10
5
10
50
100
250
500
1000
1
2
2
3
4
5
6
7
5
10
50
100
250
500
1000
HOURS
HOURS

CHECK ENGINE OIL LEVEL DAILY



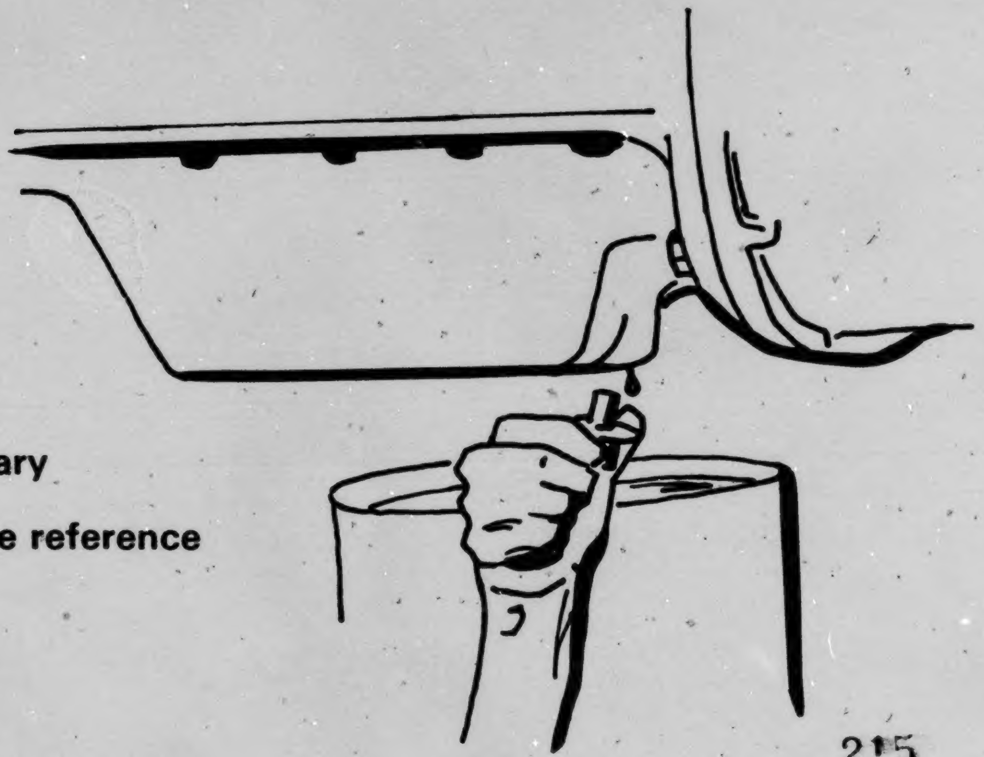
POWER LIFT


POWER
LIFT
CONTROL
POWER
LIFT

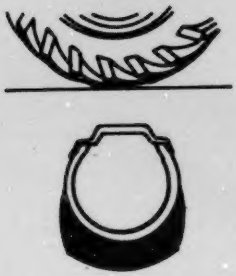
"HYDRAULIC POWER"

CHANGING CRANKCASE OIL

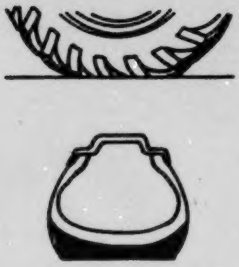
1. Warm engine
2. Remove plug
3. Remove dirt from filter
4. Remove filter
5. Clean reuseable parts
6. Replace plug & new filter
7. Fill with oil
8. Operate engine
9. Check for leaks
10. Check oil level—add if necessary
11. Clean tools and area
12. Record hours & date for future reference



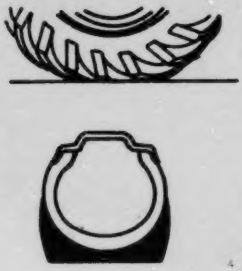
WHICH TIRE HAS THE PROPER PRESSURE?



A



B



C

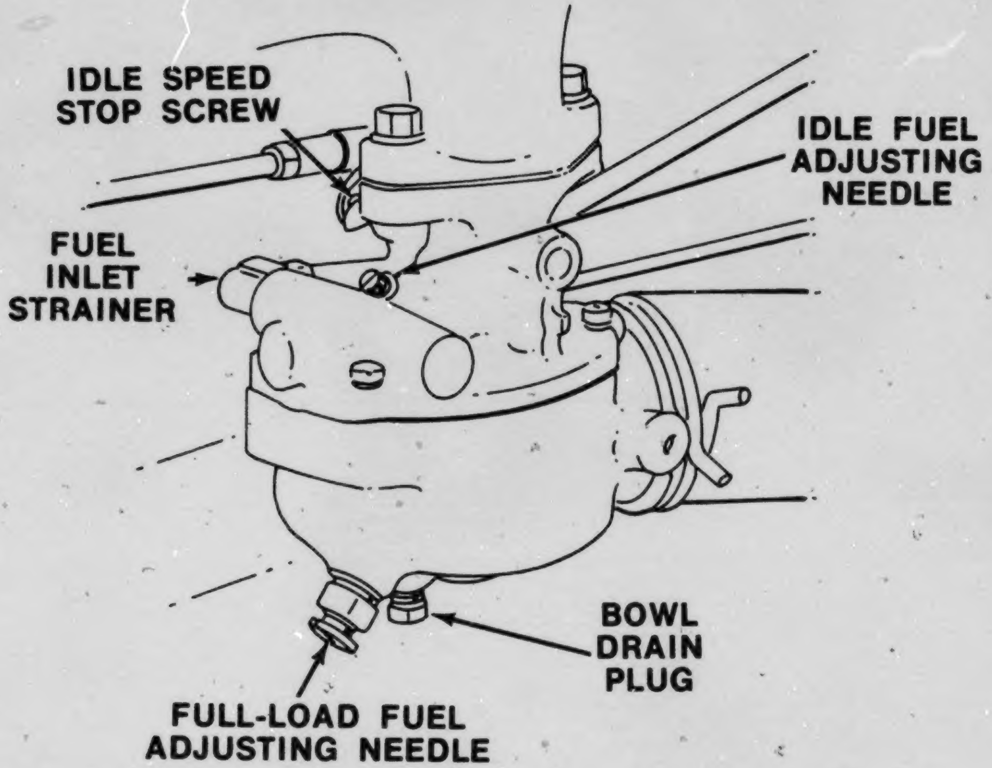
WHAT ARE THE SYMPTOMS OF IMPROPER TIRE INFLATION?

1. ____________________________________

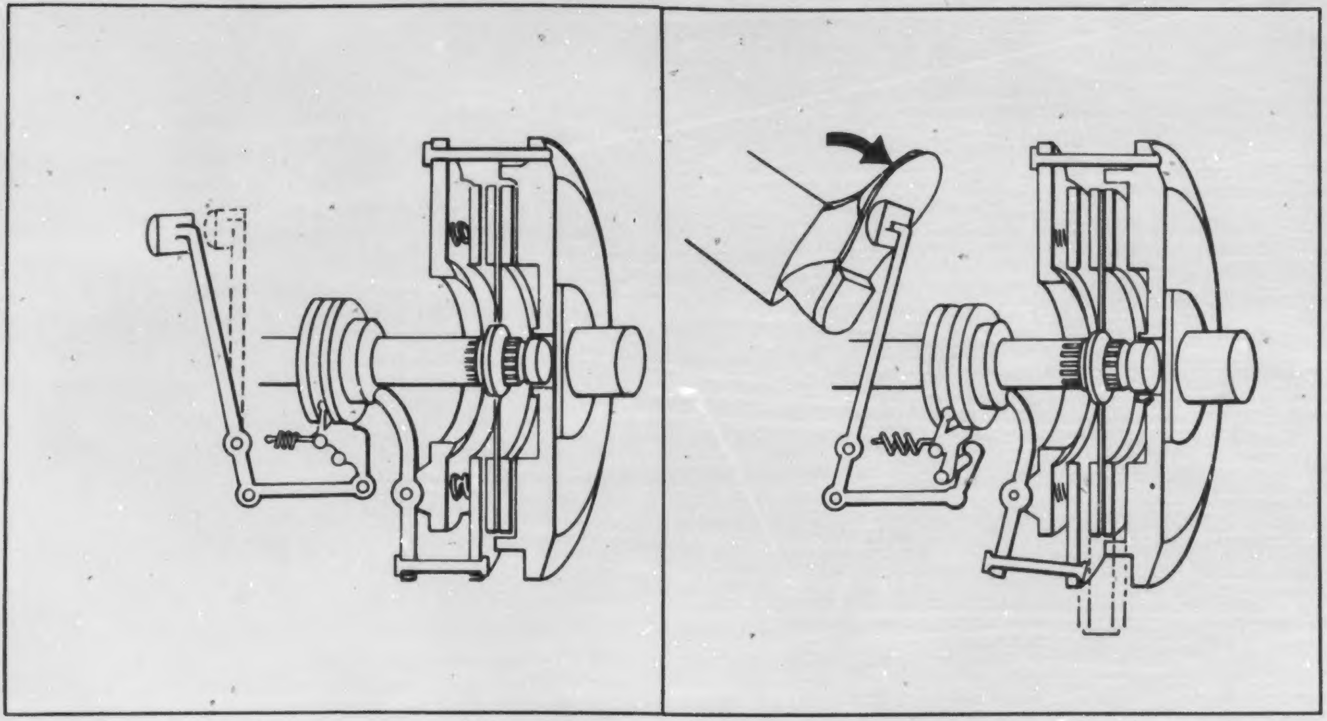
2. ____________________________________

3. ____________________________________

ADJUSTMENTS ON GASOLINE CARBURETOR

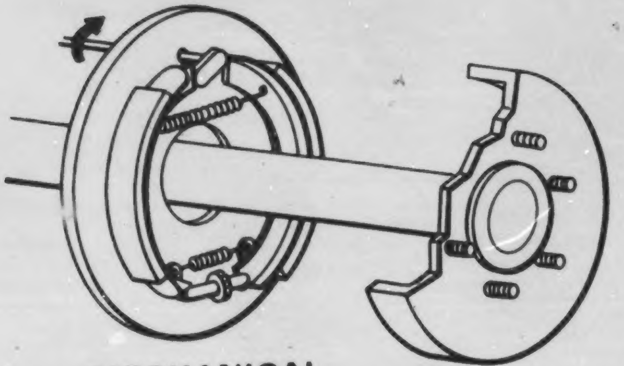

IDLE SPEED STOP SCREW
IDLE FUEL ADJUSTING NEEDLE
FUEL INLET STRAINER
BOWL DRAIN PLUG
FULL-LOAD FUEL ADJUSTING NEEDLE

TYPICAL CLUTCH OPERATION

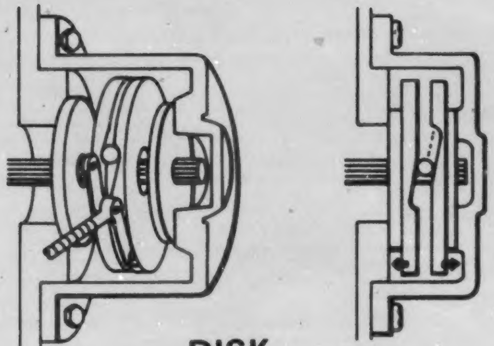


ENGAGED **DISENGAGED**

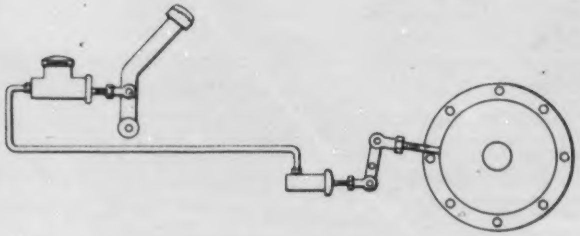
TYPES OF BRAKE SYSTEMS



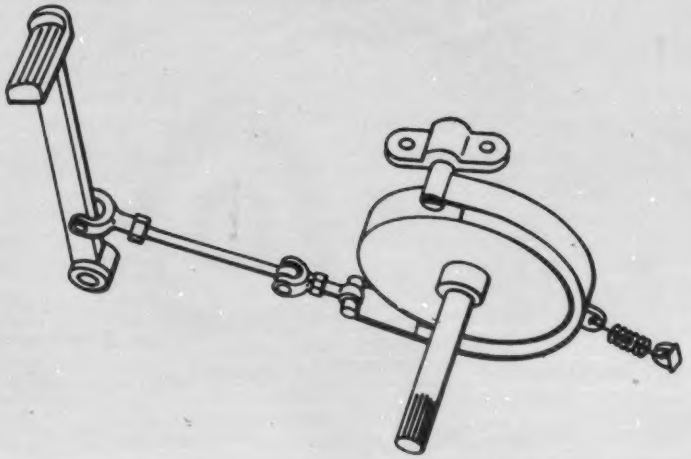
MECHANICAL



DISK

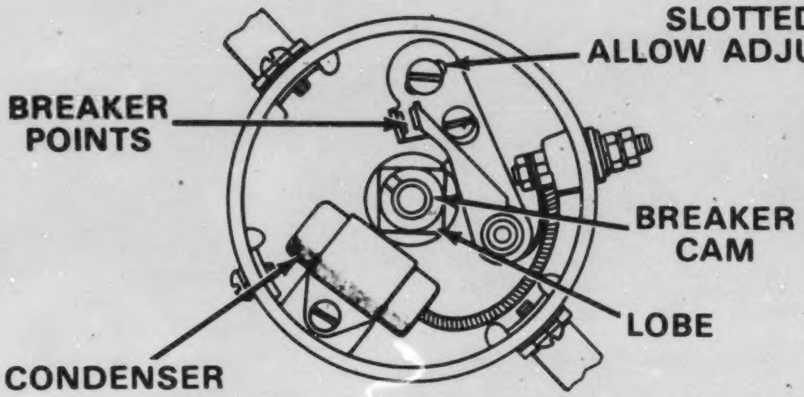


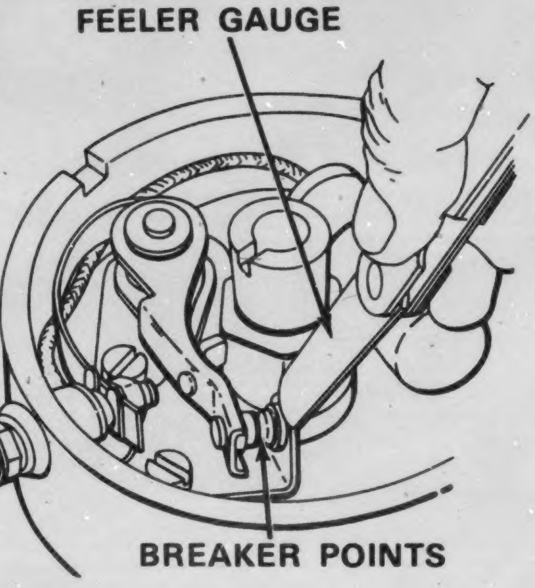
HYDRAULIC



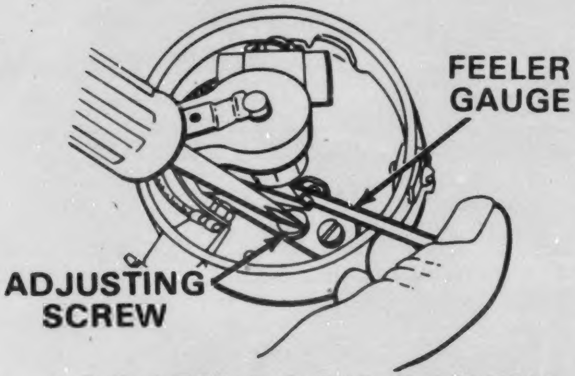
BAND

HOW TO ADJUST DISTRIBUTOR


SLOTTED TO ALLOW ADJUSTMENT
BREAKER POINTS
BREAKER CAM
LOBE
CONDENSER

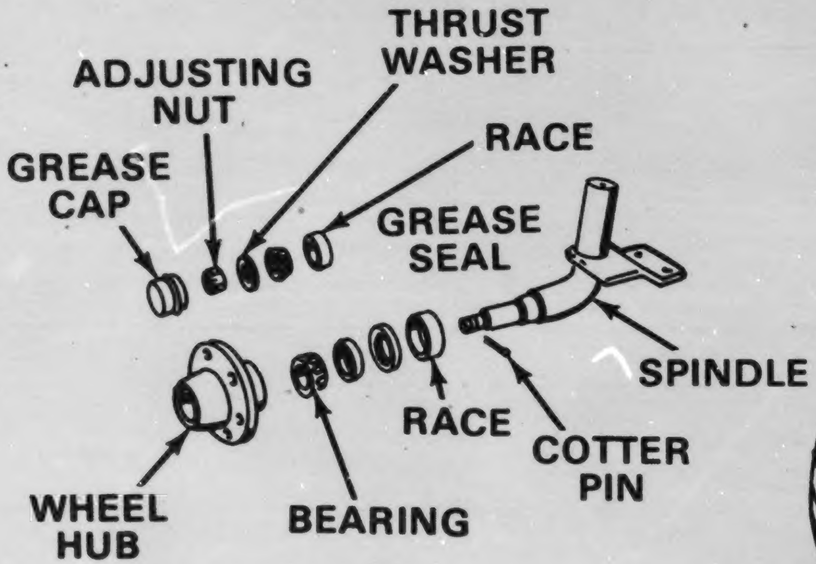

FEELER GAUGE
BREAKER POINTS

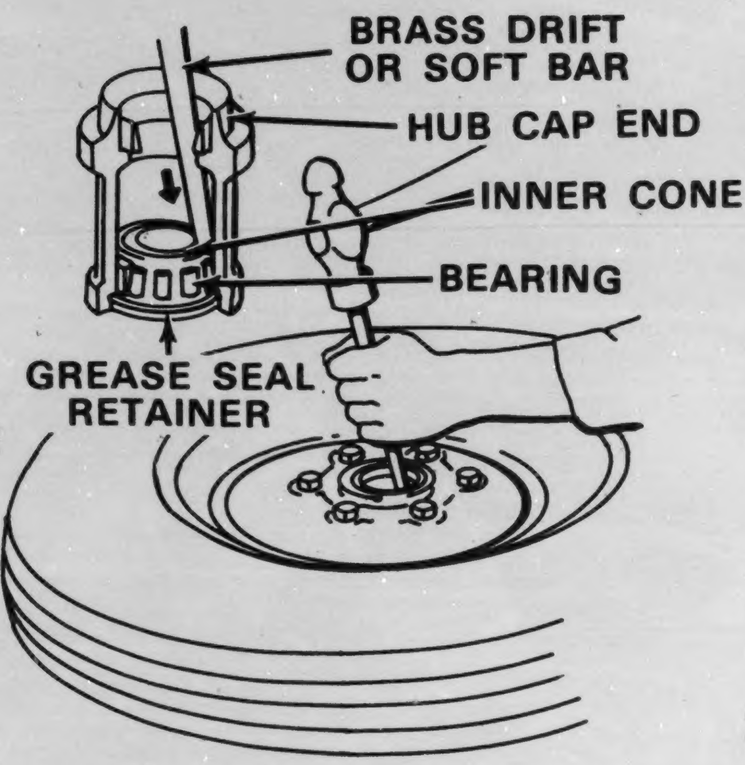
USING FEELER GAUGE


FEELER GAUGE
ADJUSTING SCREW

A - LOOSEN LOCK SCREW
B - ADJUST POINTS WITH ADJ. SCREW

SERVICING WHEEL BEARINGS


THRUST WASHER
ADJUSTING NUT
RACE
GREASE CAP
GREASE SEAL
SPINDLE
RACE
COTTER PIN
WHEEL HUB
BEARING


BRASS DRIFT OR SOFT BAR
HUB CAP END
INNER CONE
BEARING
GREASE SEAL RETAINER

PREVENTIVE MAINTENANCE

JOB SHEET #1 - SERVICING OIL BATH AIR CLEANER

I. Tools and materials needed:

   A. Clean rags

   B. Cleaning solvent

   C. Open end wrenches

   D. Screwdriver

   E. Pliers

II. Procedure:

   A. Remove oil cap and screen tray.

   B. Check sediment depth.

      NOTE: If sediment is more than ½" in depth, clean cup.

   C. Inspect center tube and lower filter element.

   D. Remove dirt from center tube.

   E. Clean lower filter.

   F. Clean shell and upper metal wool filter.

   G. Drain body and screen.

   H. Clean pre-cleaner.

   I. Refill cup to "oil level" mark.

      NOTE: Refer to operators manual for recommended replacement oil.

PREVENTIVE MAINTENANCE

JOB SHEET #2 - CHANGING ENGINE OIL AND FILTER

I. Tools and materials needed:

A. Clean rags

B. Wrenches for two drain plugs and filter cap

C. Container for old oil

D. New oil recommended by tractor manufacturer

E. New filter cartridge

F. Cleaning solvent

II. Procedure:

A. Operate engine until thoroughly heated.

NOTE: Engine oil drains more completely when hot.

B. Remove drain plug.

C. Allow crankcase to drain.

D. Loosen filter bowl or cover and remove.

E. Discard old filter cartridge.

F. Clean filter bowl and base.

G. Install new filter gasket.

H. Install new filter cartridge.

I. Install filter bowl.

J. Replace drain plug in oil pan.

K. Fill crankcase with proper oil recommended by manufacturer.

L. Operate engine and check for leaks.

M. Check oil level, add if needed.

PREVENTIVE MAINTENANCE

JOB SHEET #3 - CHANGING SPARK PLUGS

I. Tools and materials needed:

   A. Spark plug wrench

   B. Feeler gauge

   C. Replacement plugs

II. Procedure:

   A. Remove spark plug wires.

   B. Remove each plug.

   C. Check plug condition.

   D. Check compression of each cylinder.

   E. Gap new plugs.

   NOTE: Refer to operators manual for proper plug gap.

   F. Replace plug and tighten with fingers.

   NOTE: Tightening with fingers prevents thread stripping with plug wrench.

   G. Tighten spark plugs with spark plug wrench.

   H. Replace spark plug wires.

PREVENTIVE MAINTENANCE

JOB SHEET #4 - ADJUSTING THE CARBURETOR

I. Tools and materials needed:

- A. Screwdriver
- B. Pliers

II. Procedure:

- A. Set speed control at idle position.
- B. Locate idle mixture screw.
- C. Turn idle misture screw clockwise slowly until engine begins to slow down.
- D. Turn adjusting screw back slowly until engine runs smoothly.
- E. Run engine at full throttle.
- F. Turn load adjusting screw clockwise until engine loses power.
- G. Turn adjusting screw counterclockwise until engine gives off black smoke from exhaust.
- H. Turn adjusting screw back until engine runs smoothly and at full speed.

PREVENTIVE MAINTENANCE

JOB SHEET #5 - CHANGING POINTS AND CONDENSER

I. Tools and materials needed:

- A. Screwdriver
- B. Clean rags
- C. Feeler gauge
- D. Replacement parts (set of points and condenser)

II. Procedure:

- A. Remove dirt from the outside of distributor cap.
- B. Remove cap and check for cracks.

  NOTE: If cap is cracked or chipped in any way or if cap shows excessive wear, replace with a new cap.
- C. Remove distributor rotor.
- D. Remove breaker point assembly and condenser.
- E. Replace worn points and condenser with new ones.
- F. Adjust point gap by turning engine until cam opens breaker points to widest position.
- G. Check points for proper spacing.
- H. Loosen lick screw on bracket that provides point adjustment.
- I. Adjustment point proper setting (refer to owners manual).
- J. Retighten points and recheck point gap.
- K. Replace rotor and distributor cap.

PREVENTIVE MAINTENANCE

JOB SHEET #6 - CHANGING DIESEL FUEL FILTER

I. Tools and materials needed:

   A. Clean rags
   B. Cleaning solvent
   C. Container for waste diesel fuel
   D. Open end wrenches
   E. Replacement filters

II. Procedures

   A. Turn off fuel supply
   B. Clean outside of filter and engine around filter
   C. Drain fuel from filter
   D. Remove oil filters
   E. Clean inside filter bowl
   F. Install new filters
   G. Complete the filter assembly and tighten

PREVENTIVE MAINTENANCE

TEST

I. List three effects of good maintenance.

A.

B.

C.

II. Name four service jobs performed once a day.

A.

B.

C.

D.

III. List four service jobs performed every 50 hours or once a week.

A.

B.

C.

D.

IV. List four service jobs performed every 100 hours or every two weeks.

A.

B.

C.

D.

V. Name five service jobs performed every 250 hours or monthly.

A.

B.

C.

D.

E.

VI. List four service jobs performed every 500 hours or twice a year.

A.

B.

C.

D.

VII. Name two service jobs performed every 1000 hours or once a year.

A.

B.

VIII. Demonstrate the ability to:

A. Service an oil bath air cleaner.

B. Change oil and filter on a tractor engine.

C. Change the spark plugs on a tractor engine.

D. Adjust the carburetor of a tractor engine.

E. Change the points and condensers in a distributor.

F. Change diesel fuel filters.

NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

PREVENTIVE MAINTENANCE

ANSWERS TO TEST

I. A. Reduces equipment failures
B. Reduces operating costs
C. Reduces safety hazards

II. A. Air cleaner
B. Check engine oil
C. Coolant level
D. Tire pressure

III. A. Steering
B. Lift mechanism
C. Battery maintenance
D. Checking hydraulic oil level

IV. A. Clutch release bearing
B. Changing oil and filter
C. Servicing crankcase breather
D. Tire maintenance

V. A. Checking valve clearance
B. Changing spark plugs
C. Adjusting the carburetor
D. Adjusting clutch
E. Adjusting brakes

VI. A. Servicing the distributor
B. Checking time
C. Servicing diesel fuel filters
D. Packing front wheel bearings

VII. A. Cleaning the tractor

B. Service air cleaner assembly

VIII. Performance skills evaluated to the satisfaction of the instructor.

UNIT VIII

ENGINES

ENGINES

TERMINAL OBJECTIVE

Upon completion of unit VIII, the student should understand and be able to identify the major components of farm equipment engines. This knowledge will be evidenced through demonstration and by scoring at least eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

I. Name three types of engines.

II. List four major differences in these engines.

III. List six categories of horsepower.

IV. List in order four strokes of a four cycle engine.

V. Name five major parts of an intake system.

VI. Name two types of air cleaners.

VII. Name three major parts of the exhaust system.

VIII. List four components of a gas fuel system.

IX. Name two types of gas fuel systems.

X. Name two types of gas fuel pumps.

XI. Name three types of gas carburetors.

XII. List two types of governors.

XIII. List five major parts of a diesel fuel system.

XIV. Name three major types of diesel fuel injection systems.

XV. List four major parts of a LP gas system.

XVI. List five major parts of the lubricating system.

XVII. Name five major components of the cooling system.

XVIII. List ten major components of the electric system.

XIX. List ten major components of an engine.

XX. Name five components of a valve train.

XXI. List eight major parts of a piston, sleeve and crankshaft assembly.

ENGINES

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with terminal and specific objectives and information sheets.

   B. Discuss the major components of an engine.

   C. Discuss the functions of each system on an engine.

   D. Make transparencies.

   E. Give test.

II. Students:

   A. Study information sheets provided by the instructor.

   B. Take test.

INSTRUCTIONAL MATERIALS

I. Materials included in this unit:

   A. Objectives

   B. Information sheets

   C. Transparency masters

      1. TM 1 - Engine Types

      2. TM 2 - Types of Air Cleaners

      3. TM 3 - Types of Diesel Fuel Injection Systems

      4. TM 4 - Components of an Engine

   D. Test

   E. Test answers

II. References:

   A. Fundamentals of Machine Operation Tractors, Moline, Illinois, Deere and Co.

B. Brown, Arlen D., Tractor and Small Engine Maintenance, Danville, Illinois, The Interstate Printers and Publishers Inc., 1973.

C. John Deere Operators Manual, John Deere and Co.

D. Case Operators Manual, J.I. Case Co.

ENGINES

INFORMATION SHEET

I. Three types of engines:
  A. Diesel
  B. Gasoline
  C. LP gas

II. Four major differences in these engines:
  A. Fuel supply and ignition
  B. Compression ratio
  C. Engine design
  D. Type and grade of fuel

III. Six categories of horsepower:
  A. Indicated
  B. Friction
  C. Flywheel
  D. Drawbar
  E. Power take off
  F. Rated

IV. Four strokes of a four cycle engine:
  A. Intake
  B. Compression
  C. Power
  D. Exhaust

V. Five major parts of an intake system:
  A. Pre-cleaner
  B. Air cleaner

INFORMATION SHEET

- C. Intake manifold
- D. Intake valves
- E. Turbo-charger (diesel engines)

VI. Two types of air cleaners. TM 2

- A. Dry
- B. Oil bath

VII. Three major parts of the exhaust system.

- A. Exhaust valves
- B. Exhaust manifold
- C. Muffler

VIII. Four components of a gas fuel system.

- A. Fuel tank
- B. Fuel pump
- C. Fuel filters
- D. Carburetor

IX. Two types of gas fuel systems.

- A. Gravity system
- B. Force system

X. Two types of gas fuel pumps.

- A. Electric
- B. Mechanical

XI. Three types of gas carburetors.

- A. Down draft
- B. Updraft
- C. Natural draft

INFORMATION SHEET

XII. Two types of governors.

- A. Centrifugal
- B. Vacuum or automatic

XIII. Five major parts of a diesel fuel system.

- A. Fuel tank
- B. Transfer pump
- C. Filters
- D. Injection pump
- E. Fuel injectors

XIV. Three major types of diesel fuel injection systems.
TM 3

- A. Common rail system
- B. Accumulator system
- C. Jerk pump system

XV. Four major parts of the LP gas system.

- A. Pressurized fuel tank
- B. Fuel strainer
- C. Converter or vaporizer

XVI. Five major parts of the lubricating system.

- A. Oil pan
- B. Oil pump
- C. Oil filter
- D. Pressure gauge
- E. Crankcase breather

XVII. Five major components of the cooling system.

- A. Radiator
- B. Water pump

INFORMATION SHEET

- C. Thermostat
- D. Hoses
- E. Fan and fan belts

XVIII. Ten major components of the electric system.

- A. Battery
- B. Generator or alternator
- C. Voltage regulator
- D. Starter
- E. Ignition switch
- F. Gauges
- G. Lights
- H. Coil
- I. Distributor
- J. Spark plugs and wires

XIX. Ten major components of an engine. TM 4

- A. Block
- B. Crankshaft
- C. Camshaft
- D. Valves
- E. Lifters
- F. Piston rod
- G. Piston
- H. Head
- I. Intake valves
- J. Exhaust valve port

XX. Five components of a valve train.

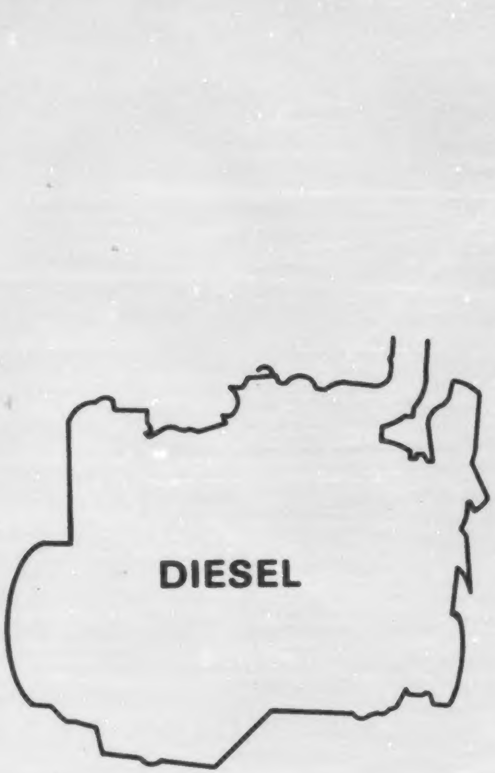
INFORMATION SHEET

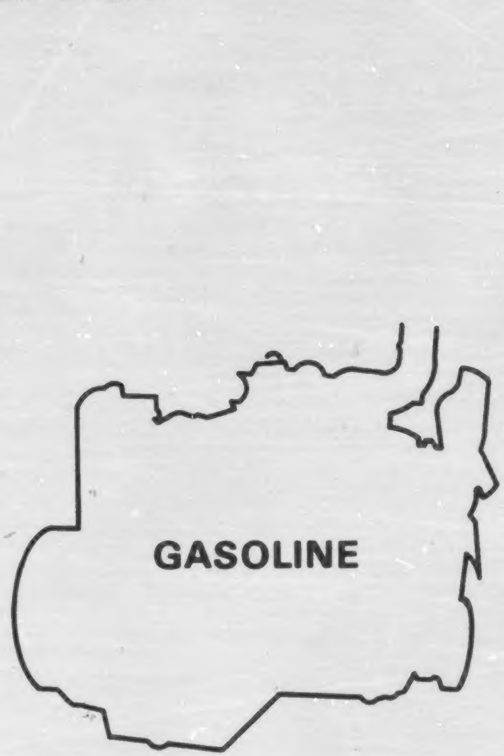
- A. Valves
- B. Push rods
- C. Lifters
- D. Camshaft
- E. Rocker arm assembly

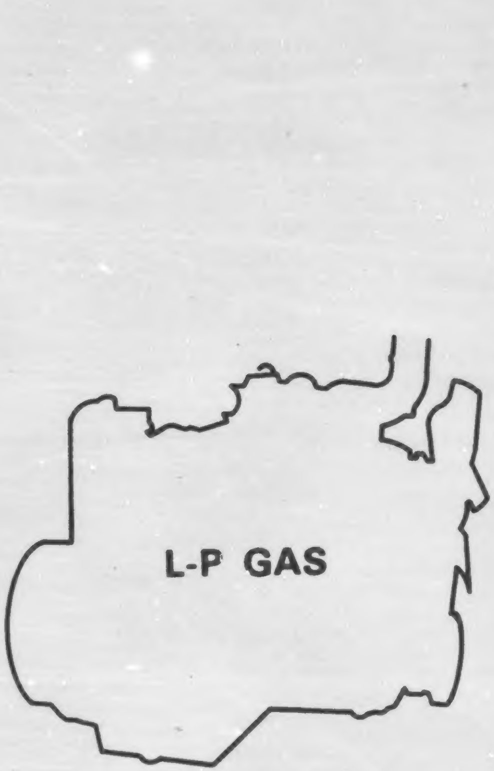
XXI. Eight major parts of a piston, sleeve and crankshaft assembly.

- A. Piston
- B. Rings
- C. Sleeve
- D. Piston pin
- E. Piston rod and cap
- F. Rod bearings
- G. Crankshaft
- H. Main bearings

ENGINE TYPES







TYPES OF AIR CLEANERS

A. DRY

B. OIL - BATH

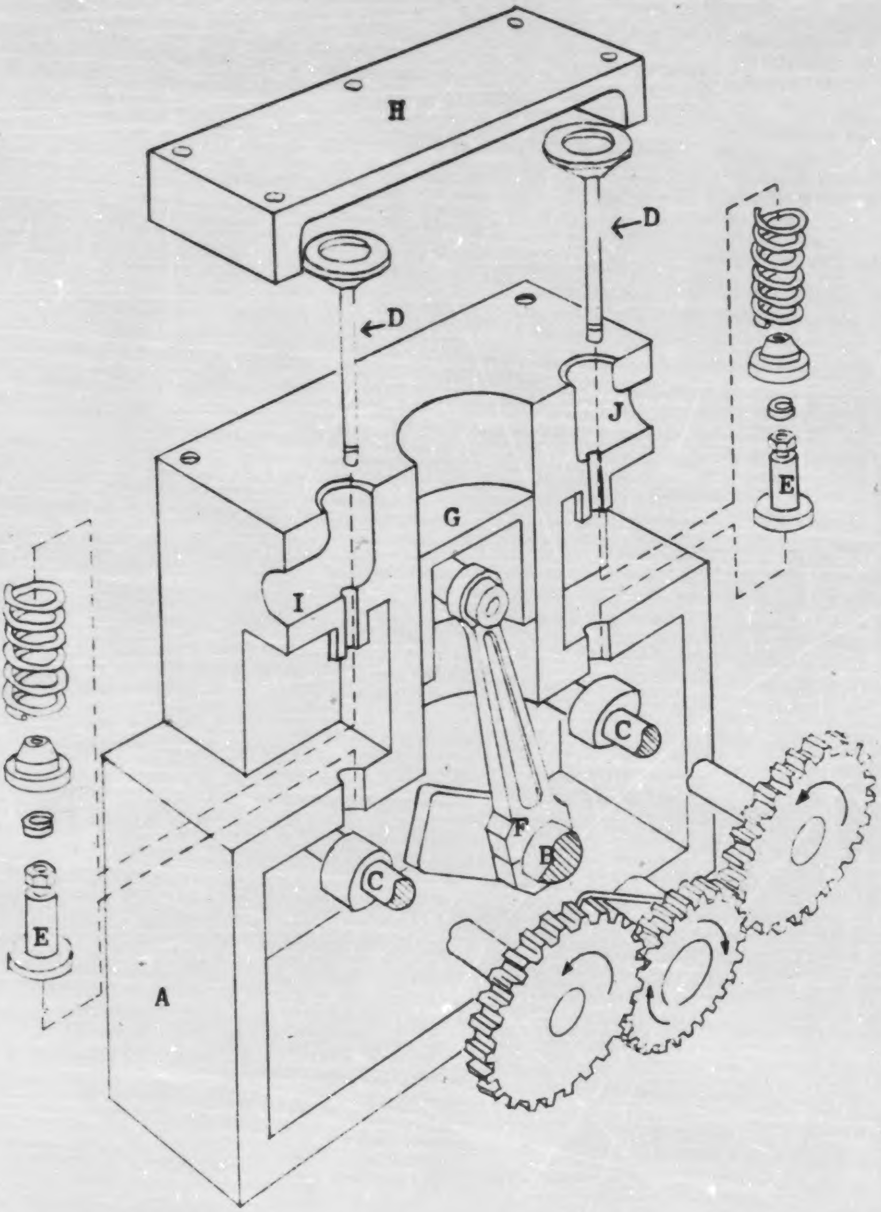
TYPES OF DIESEL FUEL INJECTION SYSTEMS

A. COMMON RAIL

B. ACCUMULATOR

C. JERK PUMP

COMPONENTS OF AN ENGINE



A. Block	F. Piston rod
B. Crankshaft	G. Piston
C. Camshaft	H. Head
D. Valves	I. Intake valve
E. Lifters	J. Exhaust valve port

ENGINES

TEST

I. Name three types of engines:

A.

B.

C.

II. List four major differences in these engines.

A.

B.

C.

D.

III. List six categories of horsepower.

A.

B.

C.

D.

E.

F.

IV. List in order, four strokes of a four cycle engine.

A.

B.

C.

D.

V. Name five major parts of an intake system.

A.

B.

C.

D.

E.

VI. Name two types of air cleaners.

A.

B.

VII. Name three major parts of the exhaust system.

A.

B.

C.

VIII. List four components of a gas fuel system.

A.

B.

C.

D.

IX. Name two types of gas fuel systems.

A.

B.

X. Name two types of gas fuel pumps.

A.

B.

XI. Name three types of gas carburetors.

A.

B.

C.

XII. List two types of governors.

A.

B.

XIII. List five major parts of a diesel fuel system.

A.

B.

C.

D.

E.

XIV. Name three major types of diesel fuel injection systems.

A.

B.

C.

XV. List four major parts of a LP gas system.

A.

B.

C.

D.

XVI. List five major parts of the lubricating system.

A.

B.

C.

D.

E.

XVII. Name five major components of the cooling system.

A.

B.

C.

D.

E.

XVIII. List ten major components of the electric system.

A.

B.

C.

D.

E.

F.

G.

H.

I.

J.

XIX. List ten major components of an engine.

A.

B.

C.

D.

E.

F.

G.

H.

I.

J.

XX. Name five components of a valve train.

A.

B.

C.

D.

E.

XXI. List eight major parts of a piston, sleeve and crank shaft assembly.

A.

B.

C.

D.

E.

F.

G.

H.

ENGINES

ANSWERS TO TEST

I. A. Diesel

B. Gasoline

C. LP gas

II. A. Fuel supply and ignition

B. Compression ratio

C. Engine design

D. Type and grade of fuel

III. A. Indicated

B. Friction

C. Flywheel

D. Drawbar

E. Power take off

F. Rated

IV. A. Intake

B. Compression

C. Power

D. Exhaust

V. A. Pre-cleaner

B. Air cleaner

C. Intake manifold

D. Intake valves

E. Turbo-charger (diesel engines)

VI. A. Dry

B. Oil bath

VII. A. Exhaust valves

B. Exhaust manifold

C. Muffler

VIII. A. Fuel tank

B. Fuel pump

C. Fuel filters

D. Carburetor

IX. A. Gravity system

B. Force system

X. A. Electric

B. Mechanical

XI. A. Down draft

B. Updraft

C. Natural draft

XII. A. Centrifugal

B. Vacuum or automatic

XIII. A. Fuel tank

B. Transfer pump

C. Filters

D. Injection pump

E. Fuel injectors

XIV. A. Common rail system

B. Accumulator system

C. Jerk pump system

XV. A. Pressurized fuel tank

B. Fuel strainer

C. Converter or vaporizer

D. Carburetor

XVI. A. Oil pan
- B. Oil pump
- C. Oil filter
- D. Pressure gauge
- E. Crankcase breather

XVII. A. Radiator
- B. Water pump
- C. Thermostat
- D. Hoses
- E. Fan and fan belts

XVIII. A. Battery
- B. Generator or alternator
- C. Voltage regulator
- D. Starter
- E. Ignition switch
- F. Gauges
- G. Lights
- H. Coil
- I. Distributor
- J. Spark plugs and wires

XIX. A. Block
- B. Crankshaft
- C. Camshaft
- D. Valves
- E. Lifters
- F. Piston rod
- G. Piston

I. Intake valve
J. Exhaust valve port
XX. A. Valves
B. Push rods
C. Lifters
D. Camshaft
E. Rocker arm assembly
XXI. A. Piston
B. Rings
C. Sleeve
D. Piston pin
E. Piston rod and cap
F. Rod bearings
G. Crankshaft
H. Main bearings

UNIT IX

HYDRAULICS

HYDRAULICS

TERMINAL OBJECTIVE

The student, upon completion of unit IX, should understand the principles of hydraulic systems of farm equipment. This knowledge will be evidenced through demonstration and by scoring at least eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

I. Define terms associated with the hydraulic system of farm equipment.

II. List nine examples of the uses of hydraulics on tractors and equipment.

III. Name two classifications of actions of a cylinder.

IV. Name three classifications of actions of the control valves.

V. Name two classifications of actions of the pumps.

VI. List six units controlled by hydraulics on self-propelled combines.

VII. Name three protection devices used to prevent dirt from entering the system.

VIII. Name two types of main filters.

IX. List eight components of a hydraulic system.

X. Name three types of hydraulic pumps.

XI. List three types of contamination in hydraulic systems.

XII. List three classes of hydraulic lines.

XIII. Name four types of hydraulic fluids.

XIV. List eight qualities a hydraulic fluid should provide.

XV. Name two types of leakage in a hydraulic system.

XVI. List seven major parts of reservoirs for hydraulic systems.

XVII. Name five principle parts of a hydraulic cylinder.

XVIII. List five signs of trouble in the operation of a cylinder.

XIX. List five signs of trouble in the operation of a pump.

XX. List four functions of an oil reservoir.

XXI. List four major causes of hydraulic system failures.

XXII. Service the hydraulic implement control system.

HYDRAULICS

SUGGESTED ACTIVITIES

I. Instructor:

  A. Provide students with terminal and specific objectives and information sheets.

  B. Discuss the terms associated with hydraulics.

  C. Discuss the fundamentals and principles of a hydraulic system.

  D. Make transparencies.

  E. Discuss and demonstrate the procedures on the job sheets.

  F. Give test.

II. Student:

  A. Study the information sheets provided by the instructor.

  B. Demonstrate the ability to perform the jobs listed on the job sheets.

  C. Take test.

INSTRUCTIONAL MATERIALS

I. Materials included in this unit:

  A. Objectives

  B. Information sheets

  C. Transparency masters

    1. TM 1 - Sources of Contamination

    2. TM 2 - Functions of the Oil Reservoir

    3. TM 3 - Cuases of Hydraulic System Failures

  D. Job sheet #1 - Servicing the Hydraulic Implement Control System

E. Test

F. Answers to test

II. References:

A. Fundamentals of Machine Operation Tractors, Moline, Illinois, Deere and Co., 1974

B. Hydraulics, Care and Operation, Volume I, American Association for Vocational Instructional Materials

C. Hydraulics, Inspecting and Testing, Volume II, Athens, Georgia, American Association for Vocational Instructional Materials, Engineering Center, 1974.

HYDRAULICS

INFORMATION SHEET

I. Terms and definitions:

   A. HYDRAULIC PRINCIPLE - Pressure applied to a fluid in a closed container is transmitted with equal intensity throughout the liquid and at right angles (perpendicular) to the surface of the container. (Pascal's Law)

II. Nine examples of the uses of hydraulics on tractors and equipment.

   A. Implement lift

   B. Draft control and weight transfer

   C. Front end loader

   D. Backhoe

   E. Dozer blade

   F. Brake

   G. Steering

   H. Remote

   I. Transmission

III. Two classifications of the actions of a cylinder.

   A. Single acting

   B. Double acting

IV. Three classifications of actions of the control valves.

   A. Direction control valve

   B. Flow control valve

   C. Pressure control valve

V. Two classifications of actions of pumps.

   A. Constant flow

INFORMATION SHEET

   B. Variable control

VI. Six units controlled by hydraulics on self-propelled combines.

   A. Stalk roll lift

   B. Platform lift

   C. Steering

   D. Ladder

   E. Unloader

   F. Hydrostatic transmission

VII. Three protection devices used to prevent dirt from entering the system.

   A. Main filter

   B. Pump screen

   C. Breather filter

VIII. Two types of main filters.

   A. In line or full flow

   B. By pass

IX. Eight components of a hydraulic system.

   A. Pumps

   B. Reservoirs

   C. Lines

   D. Coolers

   E. Fluids

   F. Cylinders

   G. Filters

   H. Motors

X. Three types of hydraulic pumps.

   A. Gear

   B. Vane

   C. Piston

XI. Three types of contamination in hydraulic systems.

INFORMATION SHEET

A. Dust

B. Moisture

C. Rust

XII. Three classes of hydraulic lines.

A. Rigid

B. Semi-rigid

C. Flexible

XIII. Four types of hydraulic fluids.

A. Gear oils

B. Special oils and fluids recommended by manufacturers.

C. Automatic transmission fluids

D. Crankcase oils

XIV. Eight qualities a hydraulic fluid should provide.

A. Resistance to oxidation

B. Protection against rust and corrosion

C. Proper viscosity

D. Protection against rapid wear

E. Resistance to foaming

F. Resistance to air collecting in the system

G. Protection for seals

H. Freedom from dirt, water or other contaminate

XV. Two types of leakage in a hydraulic system.

A. Internal

B. External

XVI. Seven major parts of reservoirs for hydraulic systems.

INFORMATION SHEET

A. Intake screen
B. Filler cap
C. Air vent
D. Dip stick
E. Drain plug
F. Inlet
G. Outlet

XVII. Five principle parts of a hydraulic cylinder.

A. Piston
B. Piston rod
C. Packing
D. Cylinder barrel
E. Seals

XVIII. Five signs of trouble in the operation of a cylinder.

A. The system will not lift a rated load.
B. The system will not lift a rated load at the proper speed.
C. The system creeps when in neutral.
D. The system does not operate smoothly.
E. The system is noisy.

XIX. Five signs of trouble in the operation of a pump.

A. System does not operate - no noise from pump.
B. System does not operate - noise present in pump.
C. System operates slowly or jerky and erratic.
D. System operates too fast.
E. Pump too noisy.

XX. Four functions of an oil reservoir. TM 2

A. Hold oil that can drain back
B. Maintain proper oil level
C. Dissipate heat
D. Allow air to escape and dirt to settle.

INFORMATION SHEET

XXI. Four major causes of hydraulic system failures.TM 3

A. Not keeping fluid at proper level

B. Not servicing of filter

C. Not using proper fluid

D. Not using correct filters

SOURCES OF CONTAMINATION

A. DUST

B. MOISTURE

C. RUST

FUNCTIONS OF AN OIL RESERVOIR

A. HOLDS OIL THAT DRAINS BACK

B. MAINTAIN PROPER OIL LEVEL

C. DISSIPATE HEAT

D. ALLOWS AIR TO ESCAPE

E. ALLOWS DIRT TO SETTLE

CAUSES OF HYDRAULIC SYSTEM FAILURE

A. IMPROPER FLUID LEVEL

B. NOT SERVING FILTER

C. IMPROPER FLUID

D. INCORRECT FILTER

HYDRAULICS

JOB SHEET #1 - SERVICING THE HYDRAULIC IMPLEMENT CONTROL SYSTEM

I. Tools and materials needed:

- A. Clean shop cloths
- B. Clening solvent
- C. Box-end or combination wrenches
- D. Container for old oil
- E. Hydraulic oil type recommended by manufacturer

II. Procedure:

NOTE: These procedures are general. Check owners manual for specific recommendations and procedures.

- A. Lower links must be in lowest position.
- B. Remove drain plug and drain oil from system.
- C. Run engine momentarily to remove oil from pump.
- D. Remove filter cover and filter element or screen.
- E. Clean filter housing and screen.
- F. Install filter and reassemble.
- G. Install drain plug.

  NOTE: Flush systems if recommended by manufacturer.
- H. Clean area around filter plug or plates.
- I. Remove filter plug or plate and add proper type of hydraulic oil.
- J. Start engine and operate lift through its cycle several times.
- K. Recheck oil level.
- L. Replace filter plug or plate.
- M. Clean hydraulic breather.

HYDRAULICS

TEST

I. Define term associated with the hydraulic system of farm equipment.

Hydraulic Principle -

II. List nine examples of the uses of hydraulics on tractors and equipment.

A.
B.
C.
D.
E.
F.
G.
H.
I.

III. Name two classifications of actions of a cylinder.

A.
B.

IV. Name three classifications of actions of the control valves.

A.
B.
C.

V. Name two classifications of actions of the pumps.

A.
B.

VI. List six units controlled by hydraulics on self-propelled combines.

A.
B.
C.
D.
E.
F.

VII. Name three protection devices used to prevent dirt from entering the system.

A.

B.

C.

VIII. Name two types of main filters.

A.

B.

IX. List eight components of a hydraulic system.

A.	E.
B.	F.
C.	G.
D.	H.

X. Name three types of hydraulic pumps.

A.

B.

C.

XI. List three types of contamination in hydraulic systems.

A.

B.

C.

XII. List three classes of hydraulic lines.

A.

B.

C.

XIII. Name four types of hydraulic fluids.

A.	C.
B.	D.

XIV. List eight qualities a hydraulic fluid should provide.

A.
E.

B.
F.

C.
G.

D.
H.

XV. Name two types of leakage in a hydraulic system.

A.

B.

XVI. List seven major parts of reservoirs for hydraulic systems.

A.
E.

B.
F.

C.
G.

D.

XVII. Name five principle parts of a hydraulic cylinder.

A.
D.

B.
E.

C.

XVIII. List five signs of trouble in the operation of a cylinder.

A.
D.

B.
E.

C.

XIX. List five signs of trouble in the operation of a pump.

A.
D.

B.
E.

C.

XX. List four functions of an oil reservoir.

A.

B.

C.

D.

XXI. List four major causes of hydraulic system failures.

A.

B.

C.

D.

HYDRAULICS

ANSWERS TO TEST

I. Pressure applied to a fluid in a closed container is transmitted with equal intensity throughout the the liquid and at right angles (perpendicular) to the surface of the container. (Pascal's Law)

II. A. Implement lift
B. Draft control and weight transfer
C. Front end loader
D. Backhoe
E. Dozer blade
F. Brake
G. Steering
H. Remote
I. Transmission

III. A. Single acting
B. Double acting

IV. A. Direction control valve
B. Flow control valve
C. Pressure control valve

V. A. Constant flow
B. Variable control

VI. A. Stalk roll lift
B. Platform lift
C. Steering
D. Ladder
E. Unloader
F. Hydrostatic transmission

VII. A. Main filter
B. Pump screen
C. Breather filter

VIII. A. In line or full flow
B. By pass

IX. A. Pumps
B. Reservoirs

C. Lines

D. Coolers

E. Fluids

F. Cylinders

G. Filters

H. Motors

X. A. Gear

B. Vane

C. Piston

XI. A. Dust

B. Moisture

C. Rust

XII. A. Rigid

B. Semi-rigid

C. Flexible

XIII. A. Gear oils

B. Special oils and fluids recommended by manufacturers.

C. Automatic transmission fluids

D. Crankcase oils

XIV. A. Resistance to oxidation

B. Protection against rust and corrosion

C. Proper viscosity

D. Protection against rapid wear

E. Resistance to foaming

F. Resistance to air collecting in the system

G. Protection for seals

H. Freedom from dirt, water or other contaminate

XV. A. Internal

B. External

XVI. A. Intake screen

B. Filler cap

C. Air vent

D. Dip stick

E. Drain plug

F. Inlet

G. Outlet

XVII. A. Piston

B. Piston rod

C. Packing

D. Cylinder barrel

E. Seals

XVIII. A. The system will not lift a rated load.

B. The system will not lift a rated load at the proper speed.

C. The system creeps when in neutral.

D. The system does not operate smoothly.

E. The system is noisy.

XIX. A. System does not operate - no noise from pump.

B. System does not operate - noise present in pump.

C. System operates slowly or jerky and erratic

D. System operates too fast.

E. Pump too noisy.

XX. A. Hold oil that can drain back.

B. Maintain proper oil level.

C. Dissipate heat.

D. Allow air to escape and dirt to settle.

XXI. A. Not keeping fluid at proper level.

B. Not servicing of filter.

C. Not using proper fluid.

D. Not using correct filters.

UNIT X

ELECTRICAL SYSTEM

ELECTRICAL SYSTEM

TERMINAL OBJECTIVE

The student, upon completion of unit X, should understand the electrical system of a tractor engine or its equivalent. This knowledge will be evidenced through demonstration and by scoring at least eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

I. Match terms associated with the electrical system of a tractor to the correct definitions or description.

II. Name the two post or terminals of a battery.

III. List four factors that affect the resistance in a circuit.

IV. Name two types of charging circuits.

V. List ten items contained in an electrical system for spark ignition.

VI. Arrange in order, four basic circuits of an electrical system of a tractor.

VII. List six major parts of a generator.

VIII. List five major parts of an alternator.

IX. List six major parts of an electric starter.

X. Name three basic functions performed by a regulator.

XI. Name two circuits contained in an ignition circuit.

XII. List four basic parts of a starting circuit.

XIII. List four basic parts of an ignition system.

XIV. Identify the major parts of an electrical system.

XV. Replace point and condenser on a tractor.

XVI. Replace spark plugs on a tractor.

ELECTRICAL SYSTEM

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with terminal and specific objectives and information sheets.

   B. Discuss the terms concerning electrical systems.

   C. Discuss the fundamentals of the electrical systems.

   D. Make transparencies.

   E. Discuss the procedures on the job sheets.

   F. Give test.

II. Students:

   A. Study the information sheets provided by the instructor.

   B. Demonstrate the ability to perform the jobs listed on the job sheets.

   C. Take test.

INSTRUCTIONAL MATERIALS

I. Materials included in this unit:

   A. Objectives

   B. Information sheets

   C. Transparency masters

      1. TM 1 - Electrical System for Spark Ignition

      2. TM 2 - Ignition Circuits - Primary

      3. TM 3 - Ignition Circuits - Secondary

   D. Job sheets

      1. Job sheet #1 - Identify the Major Parts of Electrical System

2. Job sheet #2 - Replace Breaker Points and Condenser
3. Job sheet #3 - Replace Spark Plugs

E. Test

F. Answers to test

II. References:

A. Fundamentals of Machine Operation-Tractors, Moline, Illinois, Deere and Co., 1974.

B. The Tractor Electrical System, American Association for Vocational Instructional Material, Engineering Center.

C. Tractors and Small Engine Maintenance, Danville, Illinois, The Interstate Printers and Publisher Inc., 1973.

ELECTRICAL SYSTEM

INFORMATION SHEET

I. Definitions:

   A. ELECTRICITY - Flow of electrons through a conductor.

   B. BATTERY - Is a chemical source of electrical power having two posts or terminals, one negative and one positive.

   C. CIRCUIT - A complete path of electrical current from the sources and back.

   D. INSULATOR - A material of high electrical resistance that prevents the current from deviating from the path provided.

   E. AMPERE - The unit of measurement of current.

   F. VOLTS - The unit of measurement of electrical pressure.

   G. WATTS - The unit of measurement of power.(Watt is equal to 1/746 of a horsepower.)

   H. OHMS - The unit of measurement of resistance.

   I. IGNITION SWITCH - Opens and closes the primary circuit from battery to the contact point.

   J. DISTRIBUTOR - Houses the points and condenser.

   K. IGNITION COIL - Transforms low voltage into high voltage necessary to jump the spark plug.

II. Batteries have two posts or terminals.

   A. Positive (+)

   B. Negative (-)

III. Four factors that affect the resistance in a circuit.

   A. Material the wire is made from.

   B. Diameter of the conductor.

   C. Length of conductor.

   D. Temperature of the conductor.

INFORMATION SHEET

IV. Two types of charging circuits.

  A. Direct current (Generator)

  B. Alternating current (Alternator)

V. Ten items contained in an electrical system for spark ignition. TM 1

  A. Battery

  B. Generators or alternator

  C. Voltage regulators

  D. Starter

  E. Coil

  F. Condenser

  G. Spark plug

  H. Distributor

  I. Lights

  J. Gauges

VI. Four basic circuits in a electrical system of a tractor.

  A. Starting

  B. Ignition

  C. Charging

  D. Lighting and accessory

VII. Six major parts of a generator.

  A. Armature

  B. Commutator

  C. Brushes

  D. Pole brushes

  E. Field circuit

  F. Housing

INFORMATION SHEET

VIII. Five major parts of an alternator.

- A. Stator assembly
- B. Rotor assembly
- C. Brushes
- D. Rectifier bridge
- E. Housing

IX. Six major parts of an electric starter.

- A. Brush assembly
- B. Armature
- C. Commutator
- D. Field coil
- E. Starting bendix
- F. Housing

X. Three basic functions performed by a regulator.

- A. Closes the circuit when the engine is running and opens the circuit when the engine is stopped.
- B. Prevents overcharging the battery.
- C. Prevents a high flow of current through system components causing damage.

XI. Two circuits contained in an ignition circuit.

- A. Primary circuit
- B. Secondary circuit

XII. Four basic parts of a starting circuit.

- A. Battery
- B. Starter switch
- C. Motor switch
- D. Starter motor

INFORMATION SHEET

XIII. List four basic parts of an ignition system.

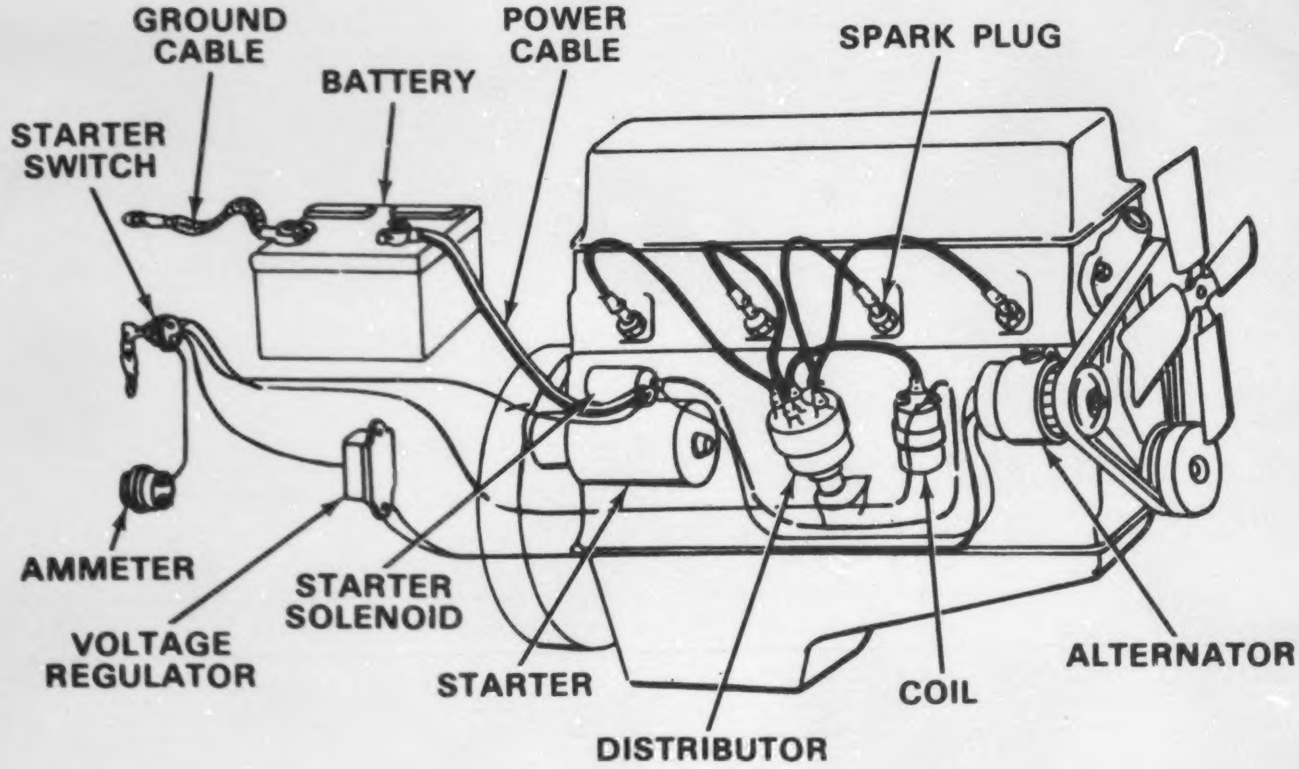
A. Ignition coil

B. Condenser

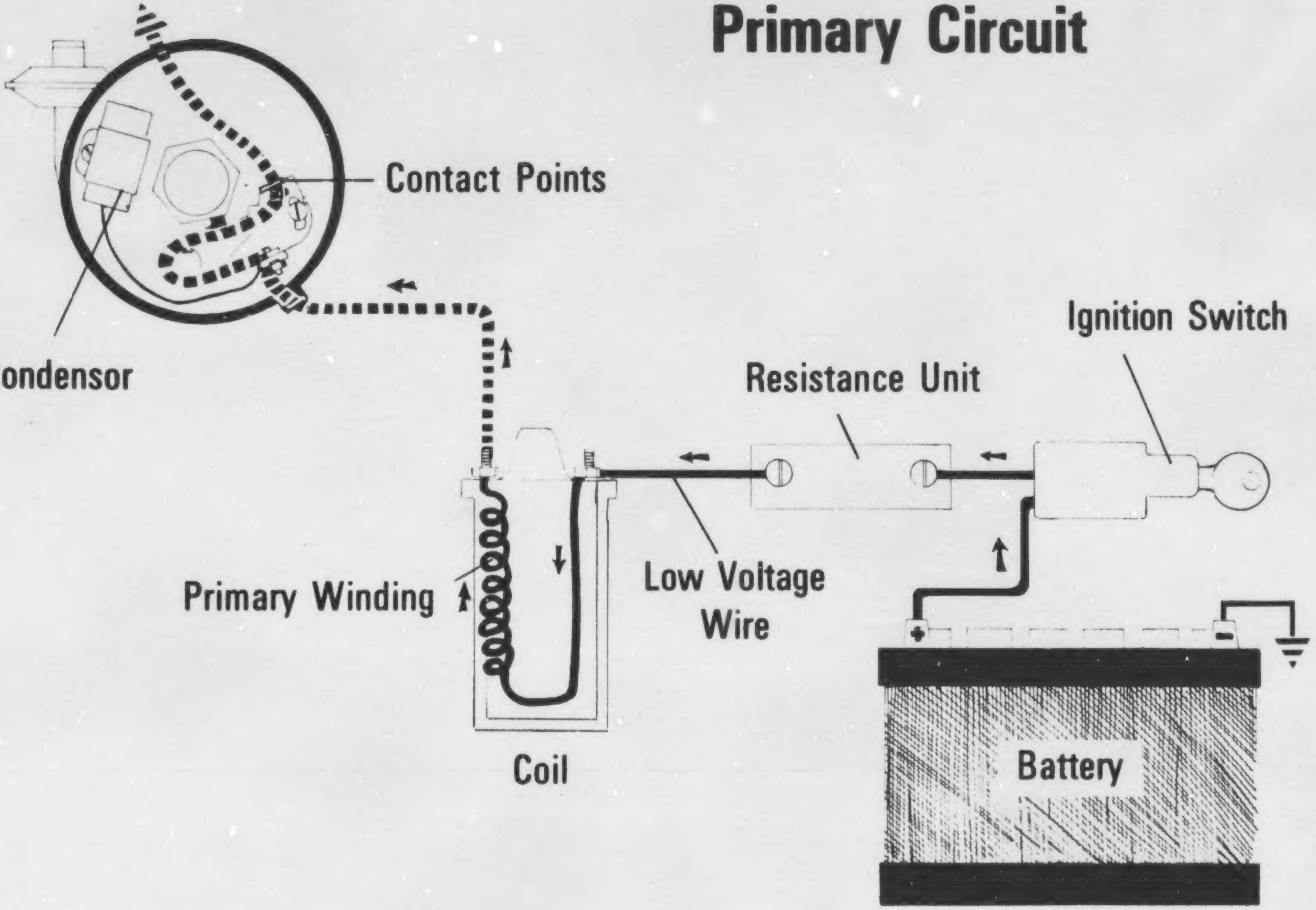
C. Distributor

D. Spark plugs

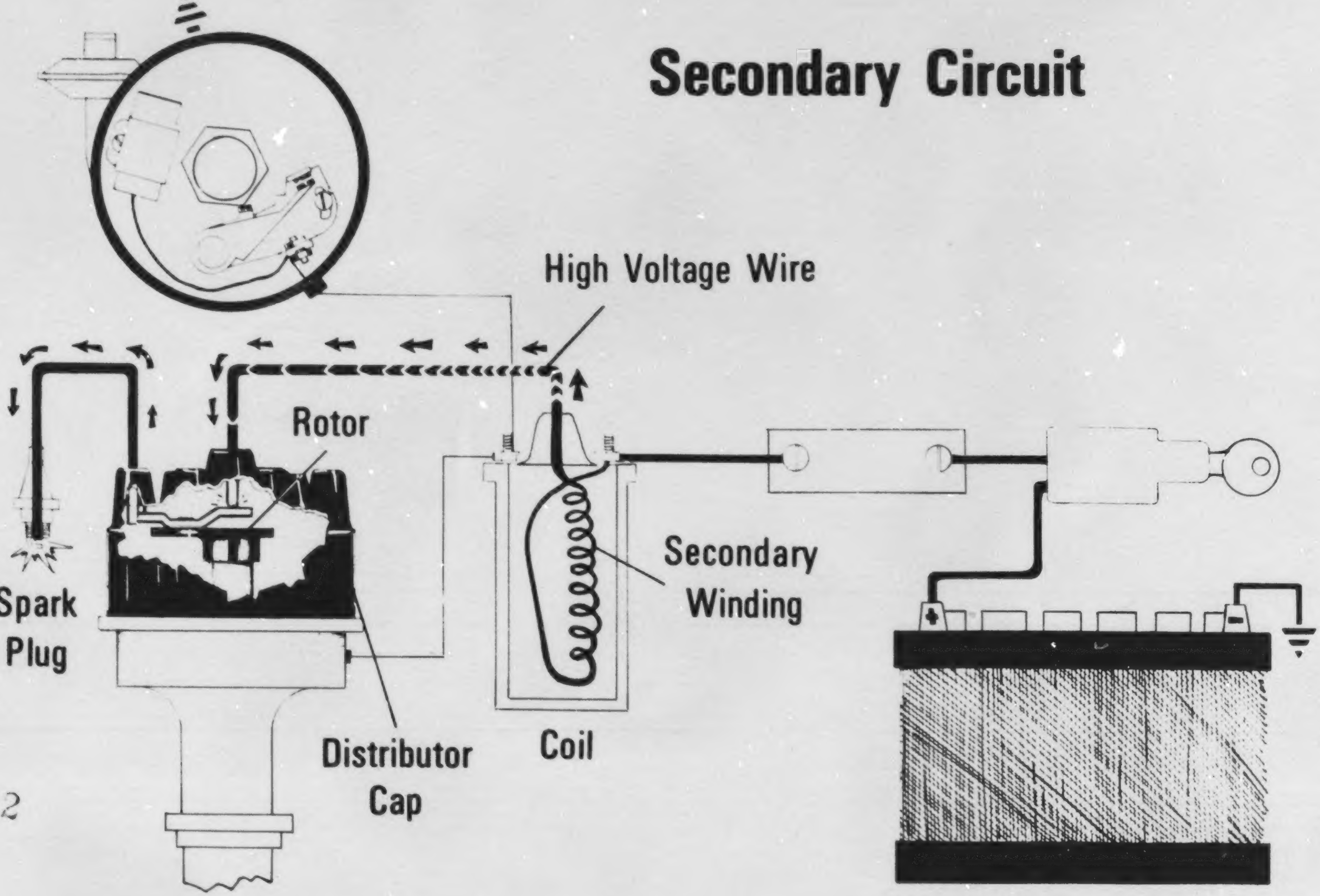
ELECTRICAL SYSTEM FOR SPARK IGNITION


GROUND CABLE
POWER CABLE
SPARK PLUG
BATTERY
STARTER SWITCH
AMMETER
STARTER SOLENOID
VOLTAGE REGULATOR
STARTER
COIL
ALTERNATOR
DISTRIBUTOR

Primary Circuit


Contact Points
Condensor
Ignition Switch
Resistance Unit
Primary Winding
Low Voltage Wire
Coil
Battery
+
−

Secondary Circuit


High Voltage Wire
Rotor
Spark Plug
Distributor Cap
Coil
Secondary Winding

ELECTRICAL SYSTEM

JOB SHEET #1 - IDENTIFY MAJOR PARTS OF ELECTRICAL SYSTEM

I. Tools and materials needed:

  A. Tractor or stationary engine

II. Procedure:

  A. Identify the major parts

  B. Major parts to identify on tractor or stationary engine:

    1. Spark plug
    2. Alternator
    3. Coil
    4. Distributor
    5. Starter
    6. Starter solenoid
    7. Voltage regulator
    8. Ammeter
    9. Starter switch
    10. Ground cable
    11. Battery
    12. Power cable

ELECTRICAL SYSTEM

JOB SHEET #2 - REPLACE BREAKER POINTS AND CONDENSER

I. Tools and materials needed:

A. Screwdriver

B. Clean rags

C. Feeler gauge

D. Replacement parts (Set of points and condenser)

II. Procedure:

A. Remove dirt from the outside of distributor cap.

B. Remove cap and check for cracks.

NOTE: If cap is cracked or chipped in any way or if cap shows excessive wear, replace with a new cap.

C. Remove distributor rotor.

D. Remove breaker point assembly and condenser.

E. Replace worn points and condenser with new ones.

F. Adjust point gap by turning engine until cam opens breaker points to widest position.

G. Check points for proper spacing.

H. Loosen lock screw on bracket that provides point adjustment.

I. Adjust point to proper setting. (Refer to owners manual)

J. Retighten points and recheck point gap.

K. Replace rotor and distributor cap.

ELECTRICAL SYSTEM

JOB SHEET #3 - REPLACE SPARK PLUGS

I. Tools and materials needed:

   A. Spark plug socket and ratchet

   B. Blow gun and air hose

   C. Replacement plugs

   D. Compression gauge

II. Procedure:

   A. Remove spark plug wires being sure to keep them in right firing order.

   B. Remove all dirt from around the plugs by using blow gun attached to an air hose.

   C. Remove spark plugs.

   D. Check engine compression.

   E. Gap new plugs. (Check owners manual)

   F. Install new plugs.

   G. Replace spark plug wires.

ELECTRICAL SYSTEM

TEST

I. Match terms associated with the electrical system of a tractor to the correct definitions or description.

___A. Electricity

___B. Ignition coil

___C. Battery

___D. Insulator

___E. Watts

___F. Volts

___G. Amperes

___H. Ohms

___I. Ignition Switch

___J. Distributor

___K. Circuit

1. Flow of electrons through a conductor.

2. Is a chemical source of electrical power having two posts or terminals, one negative and one positive.

3. A complete path of electrical current from the sources and back.

4. Material of high electrical resistance that prevents the current from deviating from the path provided.

5. The unit of measurement of current.

6. The unit of measurement of electrical pressure.

7. The unit of measurement of power.

8. The unit of measurement of resistance.

9. Opens and closes the primary circuit from battery to the contact point.

10. Houses the points and condenser.

11. Transforms low voltage into high voltage necessary to jump the spark plug.

II. Name the two posts or terminals of a battery.

A.

B.

III. List four factors that affect the resistance in a circuit.

A.

B.

C.

D.

IV. Name two types of charging circuits.

A.

B.

V. List ten items contained in an electrical system for spark ignition.

A.

B.

C.

D.

E.

F.

G.

H.

I.

J.

VI. Arrange in order, four basic circuits of an electrical system of a tractor.

A.

B.

C.

D.

VII. List six major parts of a generator.

A.

B.

C.

D.

E.

F.

VIII. List five major parts of an alternator.

A.

B.

C.

D.

E.

IX. List six major parts of an electric starter.

A.	D.
B.	E.
C.	F.

X. Name three basic functions performed by a regulator.

A.

B.

C.

XI. Name two circuits contained in an ignition circuit.

A.

B.

XII. List four basic parts of a starting circuit.

A.

B.

C.

D.

XIII. List four basic parts of an ignition system.

A.

B.

C.

D.

ELECTRICAL SYSTEM

ANSWERS TO TEST

I. A. 1
B. 11
C. 2
D. 4
E. 7
F. 6
G. 5
H. 8
I. 9
J. 10
K. 3

II. A. Positive
B. Negative

III. A. Material the wire is made from.
B. Diameter of the conductor.
C. Length of conductor.
D. Temperature of the conductor.

IV. A. Direct current
B. Alternating current

V. A. Battery
B. Generators or alternator
C. Voltage regulator
D. Starter
E. Coil
F. Condenser
G. Spark plug
H. Distributor
I. Lights
J. Gauges

VI. A. Starting
    B. Ignition
    C. Charging
    D. Lighting and accessory

VII. A. Armature
    B. Commutator
    C. Brushes
    D. Pole brushes
    E. Field circuit
    F. Housing

VIII. A. Stator assembly
    B. Rotor assembly
    C. Brushes
    D. Rectifier bridge
    E. Housing

IX. A. Brush assembly
    B. Armature
    C. Commutator
    D. Field coil
    E. Starting bendix
    F. Housing

X. A. Closes the circuit when the engine is running and opens the circuit when the engine is stopped.
    B. Prevents overcharging the battery.
    C. Prevents a high flow of current through system components causing damage.

XI. A. Primary circuit
    B. Secondary circuit

XII. A. Battery
    B. Starter switch
    C. Motor switch
    D. Starter motor

XIII. A. Ignition coil
    B. Condenser
    C. Distributor
    D. Spark plugs

UNIT XI

COMBINE OPERATION

COMBINE OPERATION

TERMINAL OBJECTIVE

The student, upon completion of unit XI, should understand the principles of operation and functions of various parts of a combine. This knowledge will be evidenced through demonstration and by scoring at least eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit the student should be able to:

I. Name two types of combines.

II. List three types of self-propelled combines.

III. Name two types of pull-type combines.

IV. List in order, five factors that determine combine size.

V. List in order, five basic crop harvesting functions performed by combines.

VI. Name three types of threshing cylinders.

VII. Name two adjustments of cylinder and concave.

VIII. List three adjustments which control the amount of air delivered to separate grain from trash.

IX. Name three methods combines clean grain.

X. Name three different places the separating occurs.

XI. List five areas that account for grain loss.

XII. List four types of headers for combines.

XIII. Name six sources of grain losses an operator must identify.

XIV. Name six usual causes of header losses.

XV. List five things a good operator must know.

XVI. List eight signs of poor combine harvesting.

XVII. Name six factors which effect combine harvesting.

XVIII. Identify 20 basic parts of a combine.

XIX. Identify 25 different operating controls.

COMBINE OPERATION

SUGGESTED ACTIVITIES

I. Instructor:

A. Provide students with terminal and specific objectives, information sheets and job sheets.

B. Discuss the principles of operation concerning combine operation.

C. Discuss the types of combines used in your area.

D. Schedule a field trip to a farm where a combine is in operation for student observation.

E. Demonstrate procedures on job sheets.

F. Give test.

II. Students:

A. Study information sheets provided by the instructor.

B. Demonstrate the ability to perform the jobs listed on the job sheets.

C. Take test.

INSTRUCTIONAL MATERIALS

I. Materials included in this unit:

A. Objectives

B. Information sheets

C. Transparency masters

1. TM 1 - Types of Combines
2. TM 2 - Basic Harvesting Functions
3. TM 3 - Areas That Account For Grain Loss
4. TM 4 - Types of Headers
5. TM 5 - Factors That Effect Combine Harvesting

    6. TM 6 - Parts of a Combine
    7. TM 7 - Control Symbols
  D. Job sheets
    1. Job sheet #1 - Basic Parts of a Combine
    2. Job sheet #2 - Operating Controls
  E. Test
  F. Answers to test

II. References:

  A. Fundamentals of Machine Operating-Combines, Moline, Illinois, Deere and Co., 1974.
  B. John Deere Operators Manual, John Deere and Co.
  C. Case Operators Manual, J.I Case Co.

COMBINE OPERATION

INFORMATION SHEET

I. Two types of combines.

   A. Self-propelled

   B. Pull-types

II. Three types of self-propelled combines.

   A. Level-land combine

   B. Hillside combine

   C. Special combine

III. Two types of pull-type combines.

   A. PTO power

   B. Auxiliary engine

IV. Five factors that determine combine size.

   A. Engine horsepower

   B. Separator width and length

   C. Type of threshing cylinder

   D. Size of header

   E. Capacity of grain tank

V. Five basic crop harvesting functions performed by combines.

   A. Cutting and feeding

   B. Threshing

   C. Separating

   D. Cleaning

   E. Handling

VI. Three types of threshing cylinders.

   A. Rasp-bar cylinder and concave

INFORMATION SHEET

B. Spike-tooth cylinder and concave

C. Angle-bar cylinder and concave

VII. Two adjustments of cylinder and concave.

A. Speed

B. Spacing

VIII. Three adjustments which control the amount of air delivered to separate grain from trash.

A. Shutter

B. Windboard

C. Fan Speed

IX. Three methods combines clean grain.

A. By screening out larger particles.

B. By blowing out light particles.

C. By screening out the smaller particles in the recleaner.

X. Three different places the separating occurs.

A. The grate sections between the concave bars.

B. The grate below the beater.

C. The straw rack.

XI. Five areas that account for grain loss. TM 3

A. Shatter loss

B. Cutter-bar loss

C. Cylinder loss

D. Separating loss

E. Cleaning loss

XII. Four types of headers for combines. TM 4

A. Cutting platform

INFORMATION SHEET

B. Windrow pickup

C. Corn header

D. Feeder conveyer

XIII. Six sources of grain losses an operator must identify.

A. Preharvest losses

B. Header losses

C. Threshing losses

D. Straw walker losses

E. Shoe losses

F. Leakage losses

XIV. Six usual causes of header losses.

A. Grain heads missing cutter bars.

B. Grain shattered by action of knife.

C. Grain missed because of improper reel speed.

D. Grain shattered by too fast reel speed.

E. Grain thrown over in front of the reel by too low reel height.

F. Grain shattered by too fast ground speed.

XV. Five things a good operator must know.

A. Functional design of the combine.

B. Principles of operation.

C. Make proper adjustments.

D. Identify harvesting loss.

E. Maintaining efficient operation.

XVI. Eight signs of poor combine harvesting.

A. Grain losses on the ground.

INFORMATION SHEET

B. Unthreshed grain.

C. Straw chewed up excessively.

D. Grain lost from straw walkers or shoe.

E. Excessive tailing in tailing elevator.

F. Cracked grain in grain tank.

G. Trash in grain tank.

H. Marketing penalties for low quality of grain.

XVII. Six factors which effect combine harvesting. TM 5

A. Skill of operator

B. Crop field condition

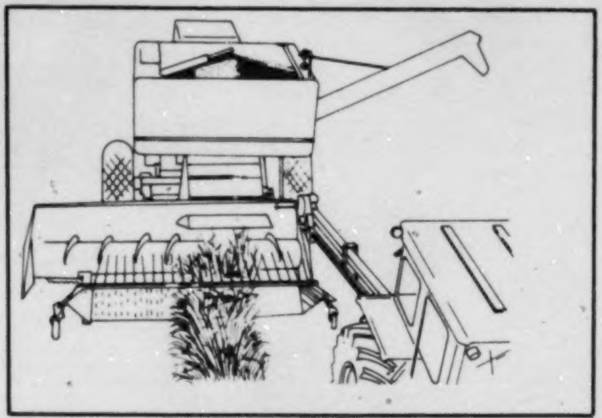
C. Adjustment of combine

D. Proper operating speed of harvesting components

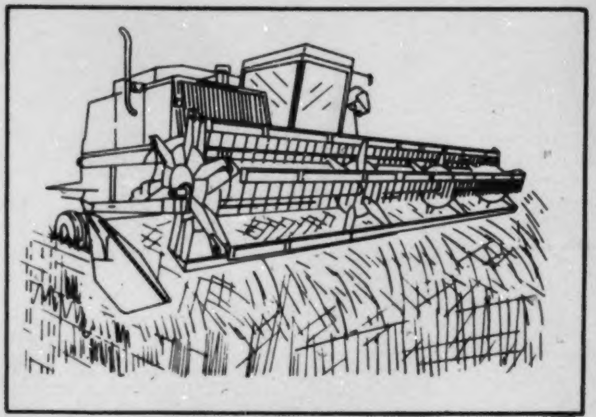
E. Ground speed of the combine

F. Width of the header

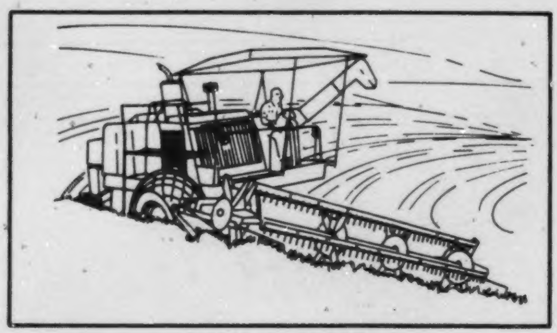
TYPES OF COMBINES



PULL-TYPE

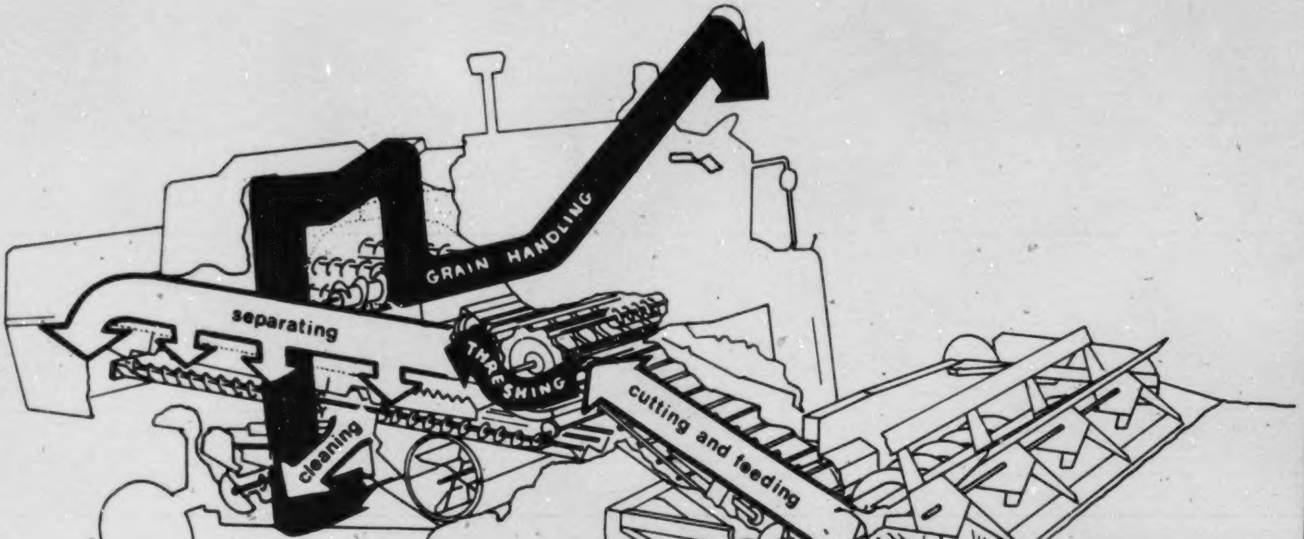


LEVEL-LAND



HILLSIDE

FLOW OF MATERIALS THROUGH A COMBINE


GRAIN HANDLING
separating
THRESHING
cutting and feeding
cleaning

AREAS THAT ACCOUNT FOR GRAIN LOSS

A. SHATTER LOSS

B. CUTTER-BAR LOSS

C. CYLINDER LOSS

D. SEPERATING LOSS

E. CLEANING LOSS

TYPES OF HEADERS

A. CUTTING PLATFORM

B. WINDROW PICKUP

C. CORN

D. FEEDER CONVEYER

FACTORS THAT EFFECT COMBINE HARVESTING

A. SKILL OF OPERATOR

B. CROP FIELD CONDITION

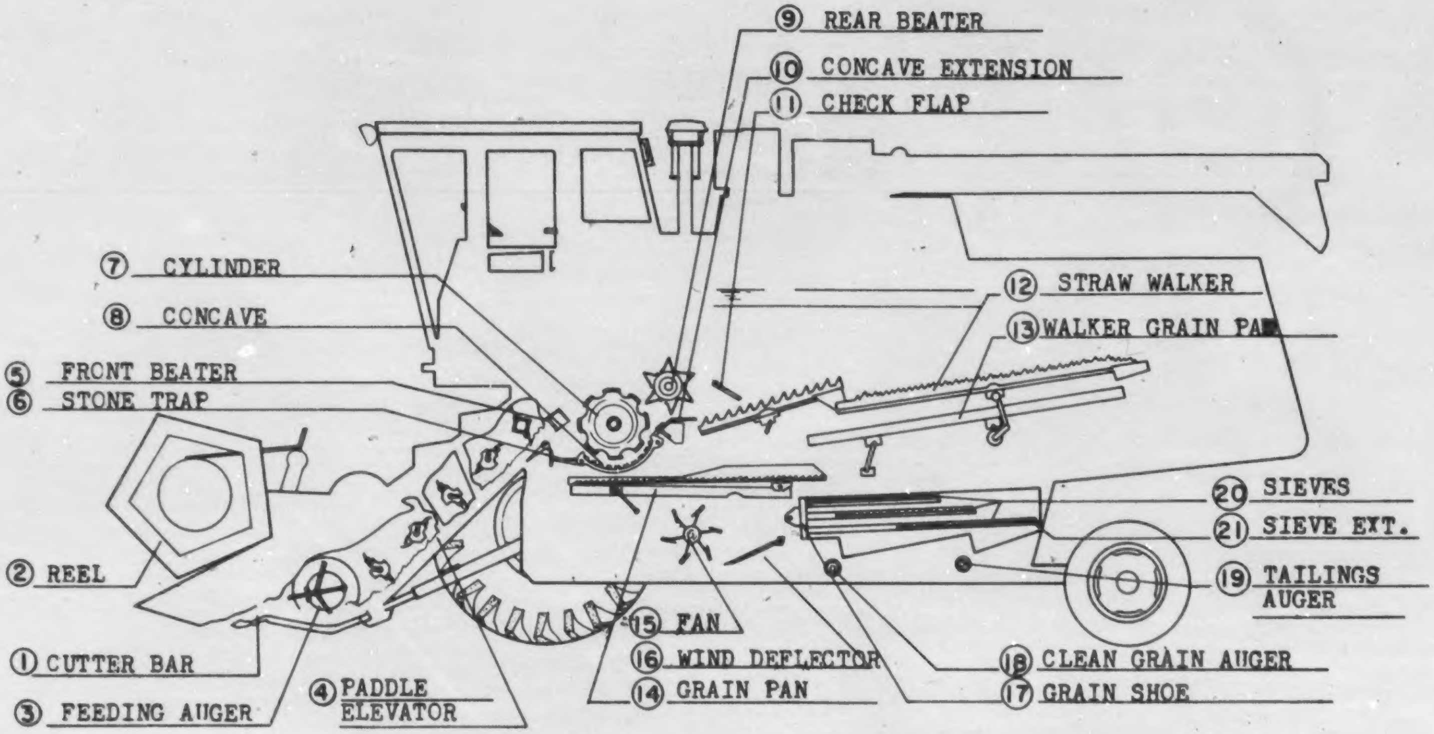
C. ADJUSTING COMBINE

D. PROPER OPERATING SPEED

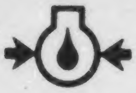
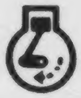
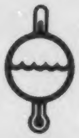
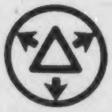
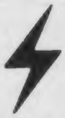
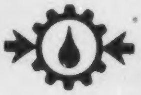
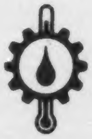
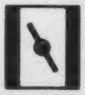
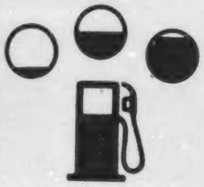
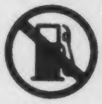
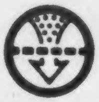
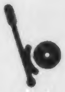
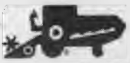
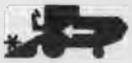
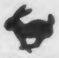
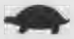
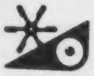
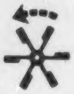
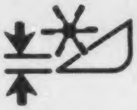
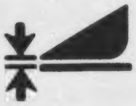
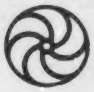
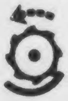
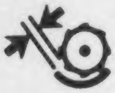
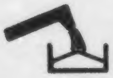
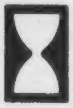
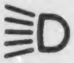
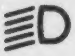
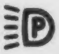
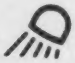
E. GROUND SPEED

F. WIDTH OF HEADER

PARTS OF COMBINE


⑨ REAR BEATER
⑩ CONCAVE EXTENSION
⑪ CHECK FLAP
⑦ CYLINDER
⑫ STRAW WALKER
⑧ CONCAVE
⑬ WALKER GRAIN PAN
⑤ FRONT BEATER
⑥ STONE TRAP
⑳ SIEVRS
㉑ SIEVE EXT.
② REEL
⑲ TAILINGS AUGER
⑮ FAN
① CUTTER BAR
⑯ WIND DEFLECTOR
⑱ CLEAN GRAIN AUGER
④ PADDLE ELEVATOR
⑭ GRAIN PAN
⑰ GRAIN SHOE
③ FEEDING AUGER

CONTROL SYMBOLS

 ENGINE OIL PRESSURE	 ENGINE RPM	 WATER TEMPERATURE	 PRESSURIZED– OPEN SLOWLY	 AMMETER OR GENERATOR LIGHT
 TRANSMISSION OIL PRESSURE	 TRANSMISSION OIL TEMPERATURE	 CHOKE	 FUEL	 FUEL SHUTOFF
 AIR FILTER	 HAND BRAKE	 ALL MECHANISMS	 GROUND SPEED	 (FAST)  (SLOW) SPEED RANGE
 PLATFORM	 REEL SPEED	 REEL HEIGHT	 PLATFORM HEIGHT	 FAN
 CYLINDER SPEED	 CONCAVE ADJUSTMENT	 UNLOADING AUGER	 HOURS	 (BRIGHT)  (DIM)  (PARK)  (WORK LIGHT) LIGHTS

COMBINE OPERATION

JOB SHEET #1 - IDENTIFY 20 PARTS OF A COMBINE

I. Tools and materials needed:

A. Copy of transparency master #6

II. Procedure:

A. Using the copy of TM 6, identify each of the 20 major parts of a combine.

COMBINE OPERATION

JOB SHEET #2 - IDENTIFY 25 CONTROL SYMBOLS

I. Tools and materials needed:

A. Copy of transparency master #7

II. Procedure:

A. Using the copy of TM 7, identify each of the control symbols for a combine.

COMBINE OPERATION

TEST

I. Name two types of combines.

A.

B.

II. List three types of self-propelled combines.

A.

B.

C.

III. Name two types of pull-type combines.

A.

B.

IV. List in order, five factors that determine combine size.

A.

B.

C.

D.

E.

V. List in order, five basic crop harvesting functions performed by combines.

A.

B.

C.

D.

E.

VI. Name three types of threshing cylinders.

A.

B.

C.

VII. Name two adjustments of cylinder and concave.

A.

B.

VIII. List three adjustments which control the amount of air delivered to separate grain from trash.

A.

B.

C.

IX. Name three methods combines clean grain.

A.

B.

C.

X. Name three different places the separating occurs.

A.

B.

C.

XI. List five areas that account for grain loss.

A.

B.

C.

D.

E.

XII. List four types of headers for combines.

A.

B.

C.

D.

XIII. Name six sources of grain losses an operator must identify.

A.

B.

C.

D.

E.

F.

XIV. Name six usual causes of header losses.

A.

B.

C.

D.

E.

F.

XV. List five things a good operator must know.

A.

B.

C.

D.

E.

XVI. List eight signs of poor combine harvesting.

A.

B.

C.

D.

E.

F.

G.

H.

XVII. Name six factors which effect combine harvesting.

A.

B.

C.

D.

E.

F.

COMBINE OPERATION

ANSWERS TO TEST

I. A. Self-propelled
B. Pull-types
II. A. Level-land combine
B. Hillside combine
C. Special combine
III. A. PTO power
B. Auxilairy engine
IV. A. Engine horsepower
B. Separator width and length
C. Type of threshing cylinder
D. Size of header
E. Capacity of grain tank
V. A. Cutting feeding
B. Threshing
C. Separating
D. Cleaning
E. Handling
VI. A. Rasp-bar cylinder and concave
B. Spike-tooth cylinder and concave
C. Angle-bar cylinder and concave
VII. A. Speed
B. Spacing
VIII. A. Shutter
B. Windboard
C. Fan speed

IX. A. By screening out larger particles.

B. By blowing out light particles.

C. By screening out the smaller particles in the recleaner.

X. A. The grate sections between the concave bars.

B. The grate below the beater.

C. The straw rack.

XI. A. Shatter loss

B. Cutter-bar loss

C. Cylinder loss

D. Separating loss

E. Cleaning loss

XII. A. Cutting platform

B. Windrow pickup

C. Corn header

D. Feeder conveyer

XIII. A. Preharvest losses

B. Header losses

C. Threshing losses

D. Straw walker losses

E. Shoe losses

F. Leakage losses

XIV. A. Grain heads missing cutter bars.

B. Grain shattered by action of knife.

C. Grain missed because of improper reel speed.

D. Grain shattered by too fast reel speed.

E. Grain thrown over in front of the reel by too low reel height.

F. Grain shattered by too fast ground speed.

XV. A. Functional design of the combine.

B. Principles of operation.

C. Make proper adjustments.

D. Identify harvesting loss.

E. Maintaining efficient operation.

XVI. A. Grain losses on the ground.

B. Unthreshed grain.

C. Straw chewed up excessively.

D. Grain lost from straw walkers or shoe.

E. Excessive tailing in tailing elevator.

F. Cracked grain in grain tank.

G. Trash in grain tank.

H. Marketing penalties for low quality of grain.

XVII. A. Skill of operator.

B. Crop field condition.

C. Adjustment of combine.

D. Proper operating speed of harvesting components.

E. Ground speed of the combine.

F. Width of the header.

UNIT XII

HAY AND FORAGE EQUIPMENT

HAY AND FORAGE EQUIPMENT

TERMINAL OBJECTIVE

The student, upon completion of unit XII, should understand basic types of hay and forage equipment. This knowledge will be evidenced through demonstration and by scoring at least eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

I. Match terms associated with hay and forage equipment to the correct definition.

II. Name six types of mowers.

III. Name four types of mower-conditioners.

IV. Name two types of hay rakes.

V. List three types of hay balers.

VI. Name four forms of processed hay.

VII. Name two types of material used in tying bales.

VIII. List six types of hay handling systems.

IX. Name three types of forage harvesters.

X. Identify the types of hay and forage equipment in the community by filling out a survey on assignment sheets.

HAY AND FORAGE EQUIPMENT

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with terminal and specific objectives, information sheets and assignment sheets.

   B. Discuss the types and uses of hay and forage equipment.

   C. Make transparencies.

   D. Discuss information and assignment sheets.

   E. Give test.

II. Students:

   A. Study the information sheets provided by instructor.

   B. Complete assignment sheets and return to instructor.

   C. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objectives

   B. Information sheets

   C. Transparency masters

      1. TM 1 - Types of Mowers

      2. TM 2 - Types of Hay Rakes

      3. TM 3 - Types of Balers

      4. TM 4 - Forms of Processed Hay

   D. Assignment sheets

      1. Assignment sheet #1 - Hay and Forage Equipment Survey

- E. Answers to assignment sheets
- F. Test
- G. Answers to test

II. References:

A. Stone, Archie A. and Gulven, Harold E., Machine for Power Farming, New York, New York, John Wiley and Sons Inc., 1967.

B. Hunt, Donnell, Farm Power and Machinery Management, Ames, Iowa, Iowa State University Press, 1968.

C. Hollenberg, A.H. and Johnson, J.H., Instruction in Farm Mechanics, Washington, United States Government Printing Office, 1964.

HAY AND FORAGE EQUIPMENT

INFORMATION SHEET

I. Definitions:

A. CRIMPER - Crushes the stems at intervals by means of corrugated rolls.

B. CRUSHERS - Crushes the entire stem between two smooth rollers.

C. MOWER - Designed to cut forage crops not grown in rows.

D. RAKE - Used to form a wind row.

E. CONDITIONER - Produces a mashing, crushing and mangling effect which increases the drying of hay crops.

F. BALER - A machine that picks up hay from a wind row, compresses and automatically ties it into easy to handle packages.

G. FORAGE HARVESTER - Chops field crops and places them into a wagon or truck.

II. Six types of mowers. TM 1

A. Rear mounted

B. Center mounted

C. Semi-mounted

D. Trailing

E. Rotary

F. Mower-conditioner

III. Four types of mower-conditioners.

A. Self-propelled mower-conditioner and windrower

B. Pull-type mower-conditioner and windrower (Haybine)

C. Pull-type conditioner

D. Centipede

INFORMATION SHEET

IV. Two types of hay rakes. TM 2

  A. Finger wheel rake

  B. Oblique reel head rake

V. Three types of hay balers. TM 3

  A. Pull-type (PTO driven)

  B. Pull-type (Auxiliary engine)

  C. Self-propelled

VI. Four forms of processed hay. TM 4

  A. Square bale

  B. Round bale

  C. Stacks (formed by stack wagon)

  D. Little round

VII. Two types of material used in tying bales.

  A. String

  B. Wire

VIII. Six types of hay handling systems.

  A. Self-propelled, one man bale harvester

  B. Tractor trailed bale harvester

  C. Mechanical bale loader

  D. Hand loaded

  E. Stack wagons and movers

  F. Hydraulic bale loader (round bale)

IX. Three types of forage harvesters.

  A. Trailing

  B. Semi-mounted

  C. Self-propelled

TYPES OF MOWERS

A. REAR MOUNTED

B. CENTER MOUNTED

C. SEMI-MOUNTED

D. TRAILING

E. ROTARY

F. MOWER CONDITIONER

TYPES OF HAY RAKES

A. FINGER WHEEL RAKES

B. OBLIQUE REEL HEAD

TYPES OF BALERS

A. PULL-TYPE-PTO

B. PULL-TYPE AUXILARY

C. SELF-PROPELLED

FORMS OF PROCESSED HAY

A. SQUARE BALE

B. ROUND BALE

C. STACKS

D. LITTLE ROUND

HAY AND FORAGE EQUIPMENT

ASSIGNMENT SHEET #1 - HAY AND FORAGE EQUIPMENT SURVEY

INSTRUCTION: From your community, develop a survey of hay and forage equipment, using the following sample outline.

DATE______________________ CURRENT SCHOOL YEAR__________

TYPE OF CROP_____________ NUMBER OF ACRES______________

	NUMBER	TYPE	AGE	OTHER
Rakes				
Balers				
Conditioners				
Mowers				
Hay Handling Systems				
Forage Harvesters				

HAY AND FORAGE EQUIPMENT

ANSWERS TO ASSIGNMENT SHEET

Assignment sheet #1

Evaluated to the satisfaction of the instructor.

HAY AND FORAGE EQUIPMENT

TEST

I. Match terms associated with hay and forage equipment to the correct definition.

___A. Crimper

___B. Crushers

___C. Mower

___D. Rake

___E. Conditioner

___F. Baler

___G. Forage Harvester

1. Used to form a wind row.
2. Crushes the entire stem between two smooth rollers.
3. Crushes the stem at intervals by means of corrugated rolls.
4. Chops field crops and places them into a wagon or truck.
5. Designed to cut forage crops not grown in rows.
6. A machine that picks up hay from a wind row, compresses and automatically ties it into easy to handle packages.
7. Produces a mashing, crushing and mangling effect which increases the drying of crops.

II. Name six types of mowers.

A.

B.

C.

D.

E.

F.

III. Name four types of mower conditioners.

A.

B.

C.

D.

IV. Name two types of hay rakes.

A.

B.

V. List three types of hay balers.

A.

B.

C.

VI. Name four forms of processed hay.

A. C.

B. D.

VII. Name two types of material used in tying bales.

A.

B.

VIII. List six types of hay handling systems.

A.

B.

C.

D.

E.

F.

IX. Name three types of forage harvesters.

A.

B.

C.

HAY AND FORAGE EQUIPMENT

ANSWERS TO TEST

I. A. 3
B. 2
C. 5
D. 1
E. 7
F. 6
G. 4

II. A. Rear mounted
B. Center mounted
C. Semi-mounted
D. Trailing
E. Rotary
F. Mower-conditioner

III. A. Self-propelled conditioner and windrower
B. Pull-type mower-conditioner and windrower (Haybine)
C. Pull-type conditioner
D. Centipede

IV. A. Finger wheel rake
B. Oblique reel head rake

V. A. Pull-type (PTO driven)
B. Pull-type (Auxiliary engine)
C. Self-propelled

VI. A. Square bale
B. Round bale

C. Stacks (formed by stack wagon)

D. Little round

VII. A. String

B. Wire

VIII. A. Self-propelled, one man bale harvester

B. Tractor trailed bale harvester

C. Machanical bale loader

D. Hand loaded

E. Stack wagons and movers

F. Hydraulic bale loader (round bale)

IX. A. Trailing

B. Semi-mounted

C. Self-propelled

UNIT XIII

MACHINERY MANAGEMENT

MACHINERY MANAGEMENT

TERMINAL OBJECTIVE

The student, upon completion of unit XIII, should understand the importance of machinery management and develop the ability to successfully manage a farming operation. This knowledge will be evidenced through demonstration and by scoring at least eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

Upon completion of this unit, the student should be able to:

I. Define five terms associated with machinery management.

II. List four typical problems of machinery management.

III. List four elements to consider when trading equipment.

IV. Name three methods of measuring machine capacity.

V. List twelve common factors that cause time loss during machinery operation.

VI. Name six factors to consider when selecting a power unit.

VII. List three reasons why farmers should be more aware of proper machinery management.

VIII. Name two types of machinery cost.

IX. List five examples of fixed cost.

X. List five examples of operating cost.

XI. Name three ways to calculate depreciation.

XII. Name three factors to consider when estimating fuel consumption.

XIII. List four factors that determine repair cost.

XIV. Name four types of repairs.

XV. List four reasons for trading machinery.

XVI. List five variables which establish the rates of custom-work.

XVII. Name three steps to estimate cost involved in custom operation.

XVIII. Figure field capacity.

XIX. Figure material capacity.

XX. Figure throughput capacity.

XXI. Calculate the speed of travel during a farming operation.

MACHINERY MANAGEMENT

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide student with terminal and specific objectives, information sheet and assignment sheets.

   B. Discuss the terms concerning machinery management.

   C. Discuss the importance of machinery management.

   D. Make transparencies.

   E. Discuss assignment sheets and demonstrate the procedures on the job sheets.

   F. Give test.

II. Students:

   A. Study information sheets provided by the instructor.

   B. Complete the assignment sheets and return to the instructor.

   C. Demonstrate the ability to perform the jobs listed on the job sheets.

   D. Take test.

INSTRUCTIONAL MATERIALS

I. Materials included in this unit:

   A. Objectives

   B. Information sheets

   C. Transparency masters

      1. TM 1 - Estimating Fixed Costs for Machinery

      2. TM 2 - Operating Costs

      3. TM 3 - Three Depreciation Methods

      4. TM 4 - Know These Lost-Time Factors

- D. Assignment sheets
    - 1. Assignment sheet #1 - Figuring Field Capacity
    - 2. Assignment sheet #2 - Figuring Material Capacity
    - 3. Assignment sheet #3 - Figuring Throughput Capacity
    - 4. Assignment sheet #4 - Figuring Theoretical Capacity
    - 5. Assignment sheet #5 - Figuring Effective Field Capacity
- E. Answers to assignment sheets
- F. Job sheet
    - 1. Job sheet #1 - Calculating Speed of Travel of Farming Equipment
- G. Test
- H. Test answers

II. References:

- A. Fundamentals of Machine Operation-Machinery Management, Moline, Illinois, Deere and Co., 1974
- B. Hunt, Donnell, Farm Power and Machinery Management, Department of Agricultural Engineering, University of Illinois.

MACHINERY MANANGEMENT

INFORMATION SHEET

I. Definition of terms:

   A. FIELD CAPACITY - Usually expressed in acres per hour.

   B. MATERIAL CAPACITY - Measured by hundred wt. per hour.

   C. THROUGHPUT CAPACITY - Used to compare machines such as combines that separate undesirable material from desirable material.

   D. FIXED COST - Cost that usually remains the same.

   E. OPERATING COST - A fluctuating cost that depends upon expenses incured.

II. Four problems of machinery management.

   A. Amount of equipment to be owned.

   B. Size of equipment needed.

   C. Proper time to trade equipment.

   D. Hiring custom operator or leasing equipment.

III. Four elements to consider when trading equipment.

   A. Average cost per unit use.

   B. Replacement cost.

   C. Machine reliability.

   D. Net effect on profit of total farming operation.

IV. Three methods of measuring machine capacity.

   A. Field capacity

   B. Material capacity

   C. Throughput capacity

V. Twelve factors that cause time loss during machinery operation.

   A. Using partical capacity

INFORMATION SHEET

- B. Filling procedures
- C. Unloading procedures
- D. Turning and field conditions
- E. Unclogging machine
- F. Making adjustments
- G. Repairing breakdowns
- H. Servicing machines
- I. Rest stops
- J. Changing operators
- K. Checking machine performance
- L. Using unmatched machines

VI. Six factors to consider when selecting a power unit.

- A. Engine type
- B. Horsepower ratings
- C. Soil resistance to machines
- D. Tractor size
- E. Matching implements
- F. Sizing for critical work

VII. Three reasons why farmers should be more aware of proper machinery management.

- A. Increasing ownership cost
- B. Increasing labor cost
- C. Larger crop acreage per operating unit

VIII. Two types of machinery cost.

- A. Fixed
- B. Operating

INFORMATION SHEET

IX. Five examples of fixed cost.

- A. Depreciation
- B. Insurance
- C. Taxes
- D. Interest
- E. Shelter

X. Five examples of operating cost.

- A. Labor
- B. Maintenance
- C. Repairs
- D. Fuel
- E. Lubrication

XI. Three ways to calculate depreciation.

- A. Straight-line
- B. Sum-of-the-digits
- C. Declining-balance

XII. Three factors to consider when estimating fuel consumption.

- A. Horsepower-hour-capacity
- B. Fuel-types
- C. Fuel consumption

XIII. Four factors that determine repair cost.

- A. Types of repairs
- B. Calculating time-loss cost
- C. Estimating repair cost
- D. Estimating lift of equipment

INFORMATION SHEET

XIV. Four types of repairs.

   A. Routine repair

   B. Accidental damage or breakage

   C. Routine overhauls

   D. Repairs due to operators neglect

XV. Four reasons for trading machinery.

   A. The machine is unreliable

   B. The machine is worn out

   C. The machine is obsolete

   D. The annual average cost per unit is close to or reached its minimum point.

XVI. Five variables which establish the rates of custom-work.

   A. Size of field

   B. Travel distance

   C. Difficulties due to crop or field conditions

   D. Labor cost

   E. Profit or risk margins

XVII. Three steps to estimate cost involved in custom operation.

   A. Estimating annual use

   B. Determining basic cost

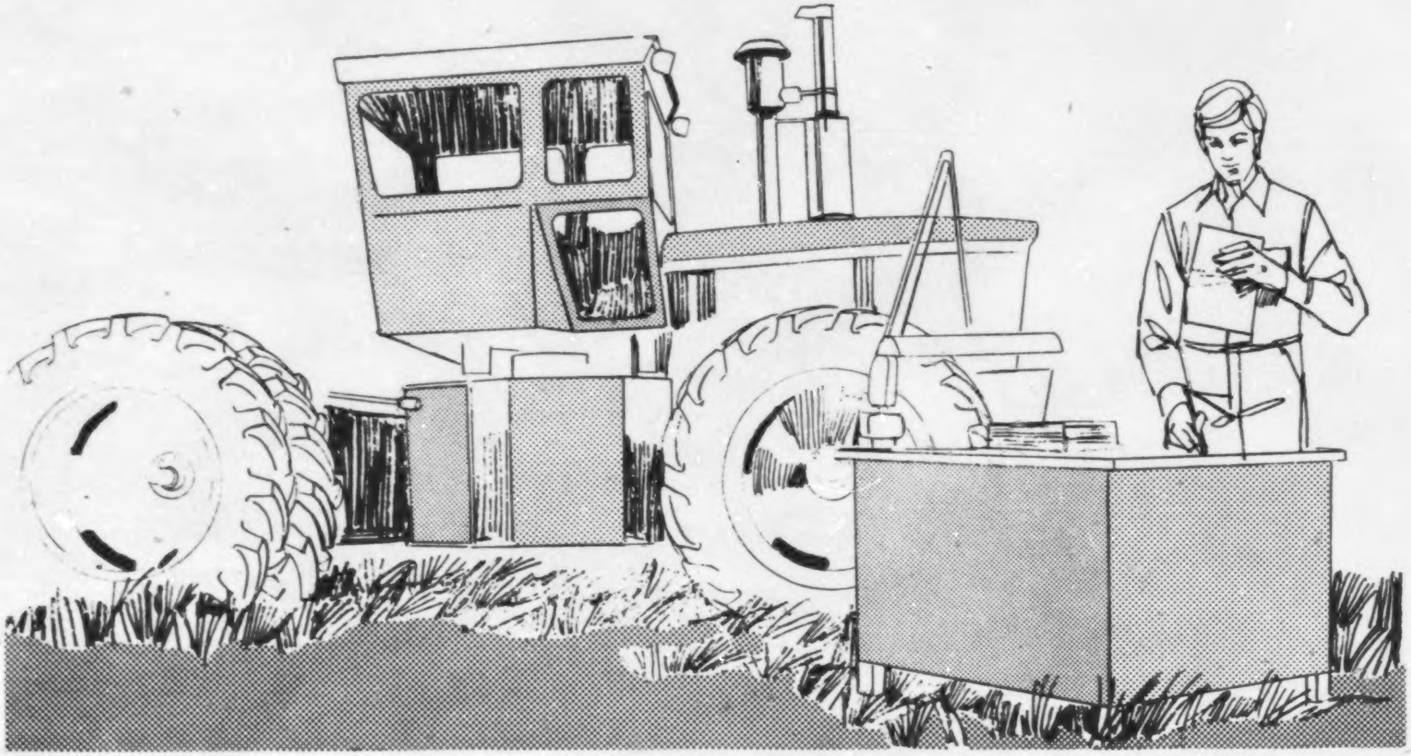
   C. Adding on profit margin

FM - 9-I

TM 1

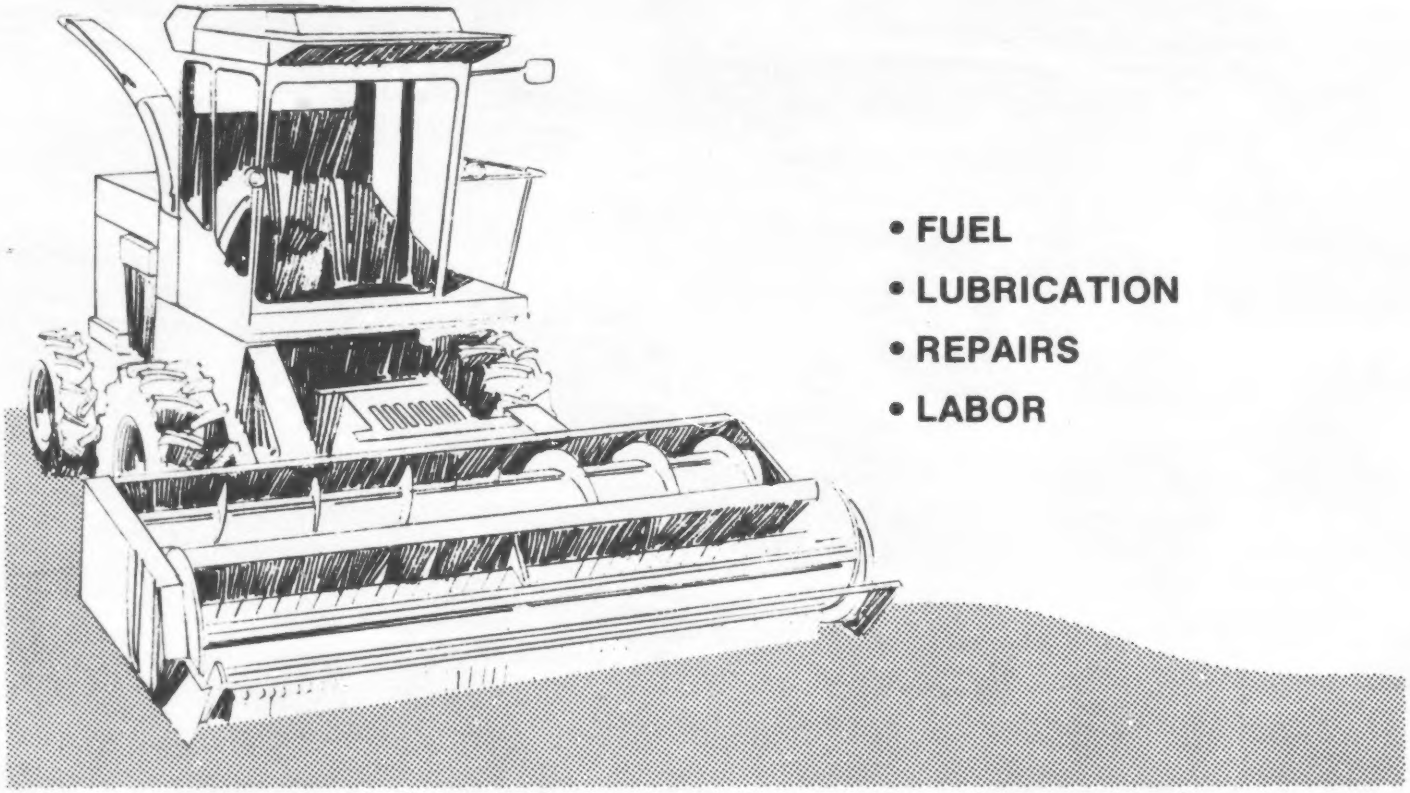
MACHINERY MANAGEMENT

ESTIMATING FIXED COSTS FOR MACHINERY



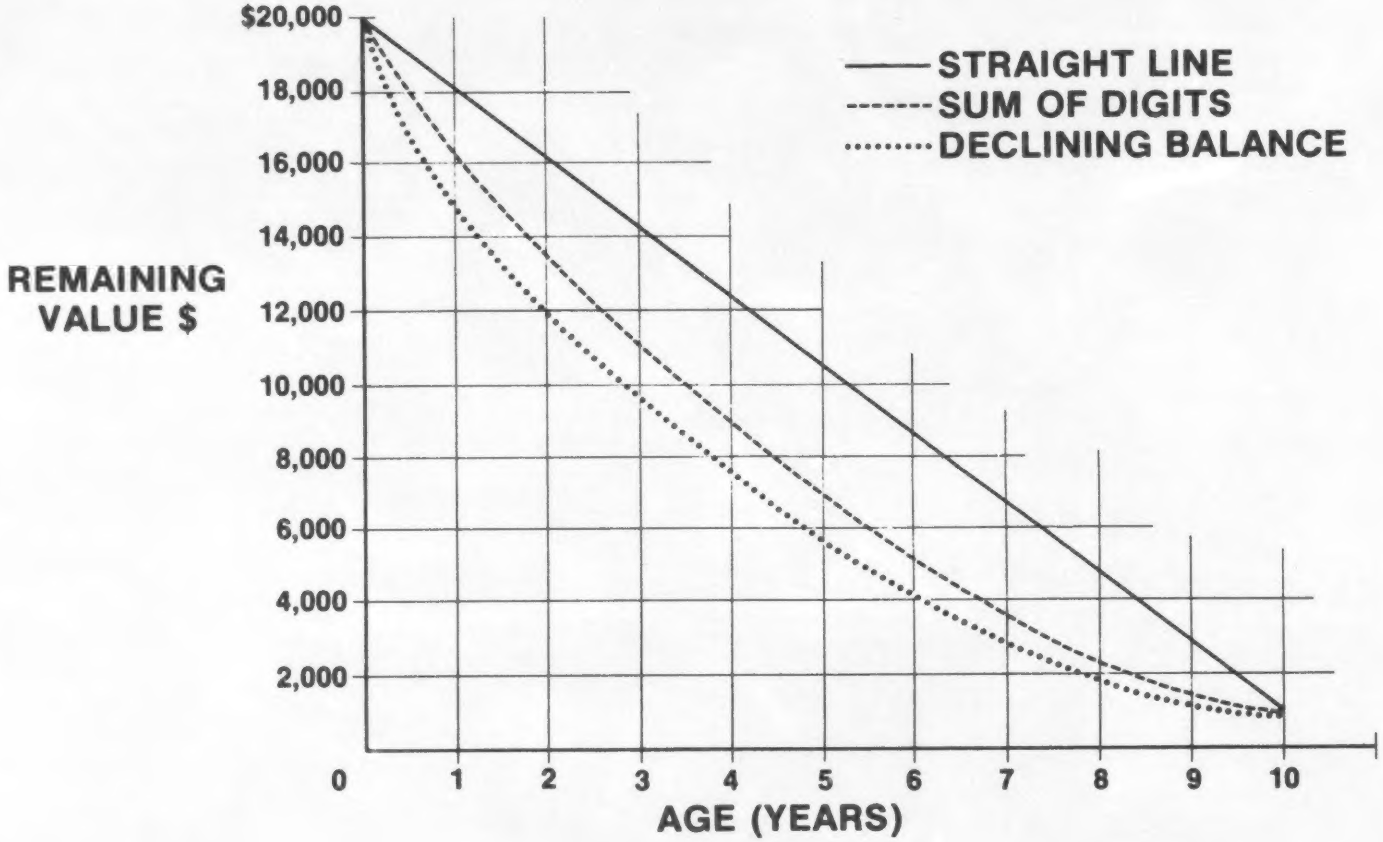
354

OPERATING COSTS INCLUDE:

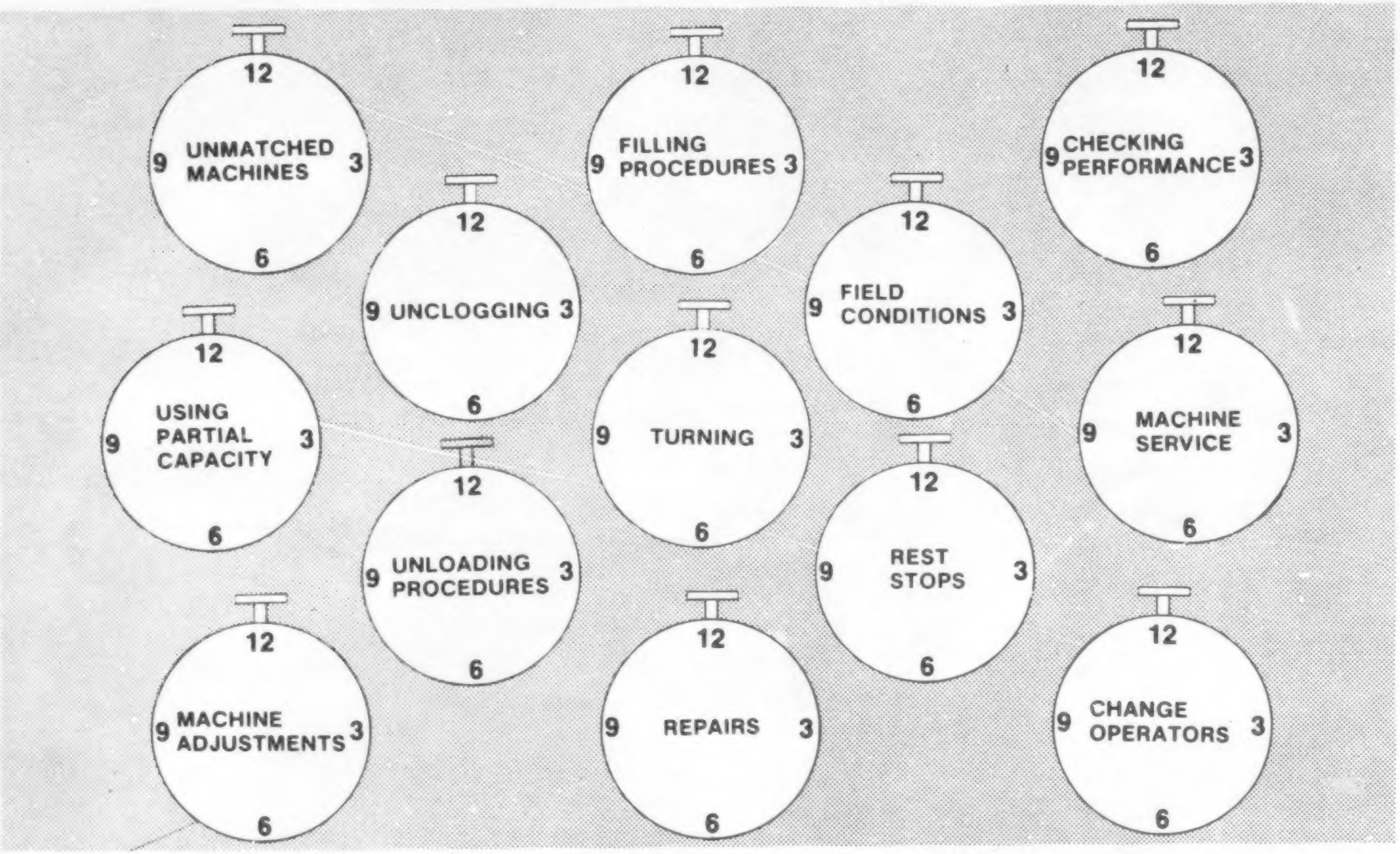


- FUEL
- LUBRICATION
- REPAIRS
- LABOR

THREE DEPRECIATION METHODS



KNOW THESE LOST-TIME FACTORS



UNMATCHED MACHINES

USING PARTIAL CAPACITY

MACHINE ADJUSTMENTS

UNCLOGGING

UNLOADING PROCEDURES

FILLING PROCEDURES

TURNING

REPAIRS

FIELD CONDITIONS

REST STOPS

CHECKING PERFORMANCE

MACHINE SERVICE

CHANGE OPERATORS

MACHINERY MANAGEMENT

ASSIGNMENT SHEET #1 - FIGURING FIELD CAPACITY

PROBLEM: Figure the field capacity of a combine with a 16 foot wide header which is combining oats at a speed of 300 feet per minute.

Speed times width equals field capacity

Sample Problem: A 10 ft. self propelled combine threshing wheat at 250 ft. per minute.

$$\frac{250 \text{ feet}}{\text{minute}} \times \frac{60 \text{ minutes}}{1 \text{ hour}} \times 10 \text{ feet} \times \frac{1 \text{ acre}}{43{,}560} \text{ ft.}^2$$

Answer = 3.44 Acres per hour

MACHINERY MANAGEMENT

ASSIGNMENT SHEET #2 - FIGURING MATERIAL CAPACITY

PROBLEM: Figure the material capacity of a combine in which 1000 pounds of material enters the header during one minute. Of this amount, 500 pounds of grain enters the grain tank and 500 pounds is discharged through the combine.

Material Capacity = Pounds harvested per hour

Sample Problem: 600 pounds of material enters a corn picker during one minute. Of this amount, 400 pounds of grain enters the grain tank and 200 pounds is discharged through the corn picker.

$$\frac{400 \text{ pounds}}{\text{minute}} \times \frac{60 \text{ minutes}}{1 \text{ hour}} \times \frac{1 \text{ Cwt.}}{100 \text{ lbs.}}$$

Answer = 240 Cwt. per hour

MACHINERY MANAGEMENT

ASSIGNMENT SHEET #3 - FIGURING THROUGHPUT CAPACITY

PROBLEM: Figure the throughput capacity of a combine in which 1000 pounds of material enters the header during one minute. Of this amount, 500 pounds of grain enters the grain tank and 500 pounds is discharged through the combine.

Throughput capacity = Total amount of material per hour

Sample Problem: 600 pounds of material enters a corn picker during one minute. Of this amount, 400 pounds of grain enters the grain tank and 200 pounds is discharged through the corn picker.

$$\frac{600 \text{ pounds}}{\text{minute}} \times \frac{60 \text{ minutes}}{1 \text{ hour}} = 36{,}000 \text{ pounds per hour}$$

$$= 18 \text{ tons per hour}$$

MACHINERY MANAGEMENT

ASSIGNMENT SHEET #4 - FIGURING THEORETICAL CAPACITY

PROBLEM: Determine the theoretical capacity of a 20 foot self-propelled combine that travels 3 mph.

Sample Problem: Determine the theoretical capacity of a 14 foot self-propelled combine that travels at 4 mph.

$$\text{Theoretical Capacity} = \frac{\text{Speed} \times \text{Width}}{8.25}$$

Note: 8.25 is a conversion factor which permits one to multiply mph times width and come out with acres per hour.

$$\frac{4 \text{ mph} \ X \ 14 \text{ feet}}{8.25} = 6.8 \text{ Acres per hour}$$

MACHINERY MANAGEMENT

ASSIGNMENT SHEET #5 - FIGURING EFFECTIVE FIELD CAPACITY

PROBLEM: Figure the effective field capacity of a 10 foot cultivator that has a 75% field capacity and is traveling at 5 mph.

$$\text{Effective Field Capactiy} = \frac{\text{Speed X Width}}{8.25} \times \frac{\text{Field Efficiency}}{100}$$

Sample Problem: The effective field capacity for a 10 foot self propelled windrower traveling 4 mph with a 70% field efficiency.

$$\frac{4 \times 10}{8.25} \times \frac{70\%}{100} \times \frac{4 \times 10 \times .70}{8.25} = 3.4 \text{ acres per hour}$$

MACHINERY MANAGEMENT

ANSWERS TO ASSIGNMENT SHEETS

Assignment sheet #1

6.61 acres per hour

Assignment sheet #2

300 Cwt per hour

Assignment sheet #3

60,000 pounds per hour
30 tons per hour

Assignment sheet #4

7.3 acres per hour

Assignment sheet #5

4.5 acres per hour

MACHINERY MANAGEMENT

JOB SHEET #1 - CALCULATING SPEED OF TRAVEL OF FARMING EQUIPMENT

I. Materials needed:

  A. Tape (100 feet)

  B. Two stakes

  C. Watch with second hand

II. Procedure:

  A. Measure off a distance of 88 feet (allow for running start)

  B. Determine in seconds the time required for the machine to travel 88 feet.

  C. Calculate the speed using the following formula:

$$\text{Miles per hour} = \frac{60}{\text{seconds to travel 88 feet}}$$

MACHINERY MANAGEMENT

TEST

I. Define terms associated with machinery management.

   A. Field capacity-

   B. Material capacity-

   C. Throughput capacity-

   D. Fixed cost-

   E. Operating cost-

II. List four typical problems of machienry management.

   A.

   B.

   C.

   D.

III. List four elements to consider when trading equipment.

   A.

   B.

   C.

   D.

IV. Name three methods of measuring machine capacity.

   A.

   B.

   C.

V. List twelve common factors that cause time loss during machinery operation.

   A.

   B.

C.

D.

E.

F.

G.

H.

I.

J.

K.

L.

VI. Name six factors to consider when selecting a power unit.

A.

B.

C.

D.

E.

F.

VII. List three reasons why farmers should be more aware of proper machinery management.

A.

B.

C.

VIII. Name two types of machinery cost.

A.

B.

IX. List five examples of fixed cost.

A.

B.

C.

D.

E.

X. List five examples of operating cost.

A.

B.

C.

D.

E.

XI. Name three ways to calculate depreciation.

A.

B.

C.

XII. Name three factors to consider when estimating fuel consumption.

A.

B.

C.

XIII. List four factors that determine repair cost.

A.

B.

C.

D.

XIV. Name four types of repairs.

A.

B.

C.

D.

XV. List four reasons for trading machinery.

A.

B.

C.

D.

XVI. List five variables which establish the rates of custom work.

A.

B.

C.

D.

E.

XVII. Name three steps to estimate cost involved in custom operation.

A.

B.

C.

MACHINERY MANAGEMENT

ANSWERS TO TEST

I. A. Usually expressed in acres per hour.

B. Measured by hundred wt. per hour.

C. Used to compare machines such as combines that separate undesirable material from desirable material.

D. Cost that usually remains the same.

E. A fluctuating cost that depends upon expenses incured.

II. A. Amount of equipment to be owned.

B. Size of equipment needed.

C. Proper time to trade equipment.

D. Hiring custom operator or leasing equipment.

III. A. Average cost per unit use.

B. Replacement cost.

C. Machine reliability.

D. Net effect on profit of total farming operation.

IV. A. Field capacity

B. Material capacity

C. Throughput capacity

V. A. Using partical capacity

B. Filling procedures

C. Unloading procedures

D. Turning and field conditions

E. Unclogging machine

F. Making adjustments

G. Repairing breakdowns

H. Servicing machines

I. Rest stops

J. Changing operators

K. Checking machine performance

L. Using unmatched machines

VI. A. Engine type
  B. Horsepower ratings
  C. Soil resistance to machines
  D. Tractor size
  E. Matching implements
  F. Sizing for critical work

VII. A. Increasing ownership cost
  B. Increasing labor cost
  C. Larger crop acreage per operating unit

VIII. A. Fixed
  B. Operating

IX. A. Depreciation
  B. Insurance
  C. Taxes
  D. Interest
  E. Shelter

X. A. Labor
  B. Maintenance
  C. Repairs
  D. Fuel
  E. Lubrication

XI. A. Straight-line
  B. Sum-of-the-digits
  C. Declining-balance

XII. A. Horsepower-hour-capacity
  B. Fuel-types
  C. Fuel consumption

XIII. A. Types of repairs
  - B. Calculating time-loss cost
  - C. Estimating repair cost
  - D. Estimating lift of equipment

XIV. A. Routine repair
  - B. Accidental damage or breakage
  - C. Routine overhauls
  - D. Repairs due to operators neglect

XV. A. The machine is unreliable
  - B. The machine is worn out
  - C. The machine is obsolete
  - D. The annual acerage cost per unit is close to or reached its minimum point.

XVI. A. Size of field
  - B. Travel distance
  - C. Difficulties due to crop or field conditions
  - D. Labor cost
  - E. Profit or risk margins

XVII. A. Estimating annual use
  - B. Determining basic cost
  - C. Adding on profit margin